MAY 2 3 1990

I 72.12/3: 90-0014

OCS Report
MMS 90-0014

Offshore Oil Terminals

Potential Role in U.S. Petroleum Distribution

MMS
U.S. Department of the Interior
Minerals Management Service
Office of Policy and Planning

OCS Report
MMS 90-0014

Offshore Oil Terminals

Potential Role in U.S. Petroleum Distribution

U.S. Department of the Interior
Minerals Management Service
Office of Policy and Planning

December 1989

II

We gratefully acknowledge the contributions of the following in preparation of this report:

American Petroleum Institute
Bechtel Pipelines
Brown and Root, Inc.
Exxon Corporation
Fenix and Scisson Division of PB-KBB Inc.
Han-Padron Associates Consulting Engineers
International Development Planners
Louisiana Offshore Oil Port Inc.
McDermott, Inc.
MIT Department of Ocean Engineering
National Ocean Industries Association
National Petroleum Council
Pacific Resources, Inc.
Pacific Texas Pipeline Company
Per Bruun International Marine Science and Engineering
Petroleum Industry Research Foundation Inc.
Salomon Brothers Inc.
Seaways Engineering Ltd.
Shell Oil Company
SOFEC Inc.
Soros Associates
Sperry Marine, Inc.
The Canadian Embassy
The Journal of Commerce
The Nautical Institute
The British Petroleum Company
Transportation Institute
Trimble Navigation
United States Army Corps of Engineers
United States Customs Service
United States Department of Energy
United States Department of Transportation
Walk, Haydel and Associates, Inc.

CONTENTS

Introduction 1

United States Energy Outlook and the Existing Petroleum Distribution Network 2

Factors in Selecting Potential Sites for Offshore Oil Terminals 6

Offshore Oil Terminals: Regulatory Background 11

Design and Cost of Offshore Oil Terminals 13

Factors in Evaluating the Feasibility of Offshore Oil Terminals 18

Funding 22

Actions to Reduce the Risk of Oil Tanker Spills 24

Conclusions 28

Endnotes 29

Illustrations

Petroleum Consumption, Production, and Imports--1988 and 2000 3

Eleven Largest U.S. Oil Ports 7

Tables

Sources of Oil Pollution in Marine Environments 18

Appendixes

I - United States Ports by Amount of Oil Handled - 1987 . . . . I-1

II - 1988 Petroleum Imports and Alaskan Crude II-1

III - Offshore Oil Terminal Cost Scenarios III-1

INTRODUCTION

Oil tanker accidents in Alaska, in harbors in Rhode Island and Texas, and in the Delaware Bay, during 1989 focused increased public attention and concern about the potential environmental risks from oil shipments going in and out of the Nation's ports. According to the National Research Council, oil spills from ships account for almost one-half of all petroleum lost at sea.

After surveying the damage resulting from the spills, the Secretary of the Interior announced that the Federal Government should consider port facilities in deep water, several miles seaward from the Nation's coastline, as a means of reducing the number of oil tankers entering U.S. ports. The Secretary also stated that the Federal Government must consider additional measures to prevent oil spills from tankers, including more stringent bonding and insurance requirements, more extensive monitoring of harbor and nearshore traffic, tighter Coast Guard controls, tougher requirements for tanker pilots, and larger fines for those who violate the rules. The Secretary directed the Minerals Management Service (MMS) to study the potential role of offshore ports in the U.S. petroleum distribution network.

This report provides the results of a review of the issues associated with the ports (referred to as offshore oil terminals), including their estimated construction and operating costs, siting and operating constraints, advantages and disadvantages, their effect on existing facilities, as well as relevant regulations. The report also provides an overview of actions that could be taken alone or in conjunction with the use of offshore oil terminals and that could potentially reduce the risk of tanker accidents.

This report generally does not address nearshore marine transportation facilities of various types currently in operation near existing onshore port and harbor complexes. Such facilities are located no more than one or two miles offshore and are usually limited in the size of tanker and volume of crude oil or refined products they can load or offload. This report also does not address crude oil and petroleum product transportation by barge and ship on inland waterways (with the exception of traffic on the Mississippi River to New Orleans and Baton Rouge) because they are too narrow for effectively siting offshore oil terminals. In addition, inland waterways are used to transport significant quantities of petroleum products in an inexpensive manner, and replacing the entire system with pipelines would be exceedingly difficult and expensive.

Except as otherwise noted, the offshore oil terminals discussed in this report would be constructed several miles offshore in deep water and would be designed to accommodate the largest classes of oil tankers in operation. To date, only one such offshore terminal--the Louisiana Offshore Oil Port (LOOP)--has been constructed and is operating in the United States. The LOOP, located in deep water 18 miles off the coast of Louisiana, became fully operational in 1982.

Before offshore oil terminal facilities are discussed, however, the following section presents an overview of the United States' energy outlook and the implications for increased tanker traffic. The section concludes by describing the existing petroleum distribution network with which offshore oil terminals would have to be integrated.

ENERGY OUTLOOK AND THE EXISTING PETROLEUM DISTRIBUTION NETWORK

The importance of reducing tanker traffic becomes clear when the likely trends in domestic oil production and petroleum imports are considered. The latest data indicate that gross imports have already exceeded 50 percent of consumption and are at the highest level since the late 1970's. By the year 2000, imports are predicted to increase to as much as 65 percent of total petroleum consumption. If domestic production is restricted, due to market forces or political choices, the percentage and quantity of imports could grow even more. The great majority of imported oil is transported to the United States by tanker.

To distribute these imports, as well as domestically produced oil, the United States has developed a highly complex and efficient network for moving crude oil and refined products to refineries and consumers throughout the country. In total, the network delivers more than 17 million barrels per day of gasoline, diesel fuel, home heating oil, jet fuel, heavy fuel oil, lubricants, petrochemical feedstocks, asphalt, and other products to gas stations, factories, farms, airports, homes and other users. Efforts to shift part or all of the tanker traffic now serving U.S. ports to offshore oil terminals could substantially impact the entire distribution network. Each individual refinery, storage depot and pipeline must be supplied with oil or be replaced. If this does not occur, supplies of petroleum products in various localities could be disrupted.

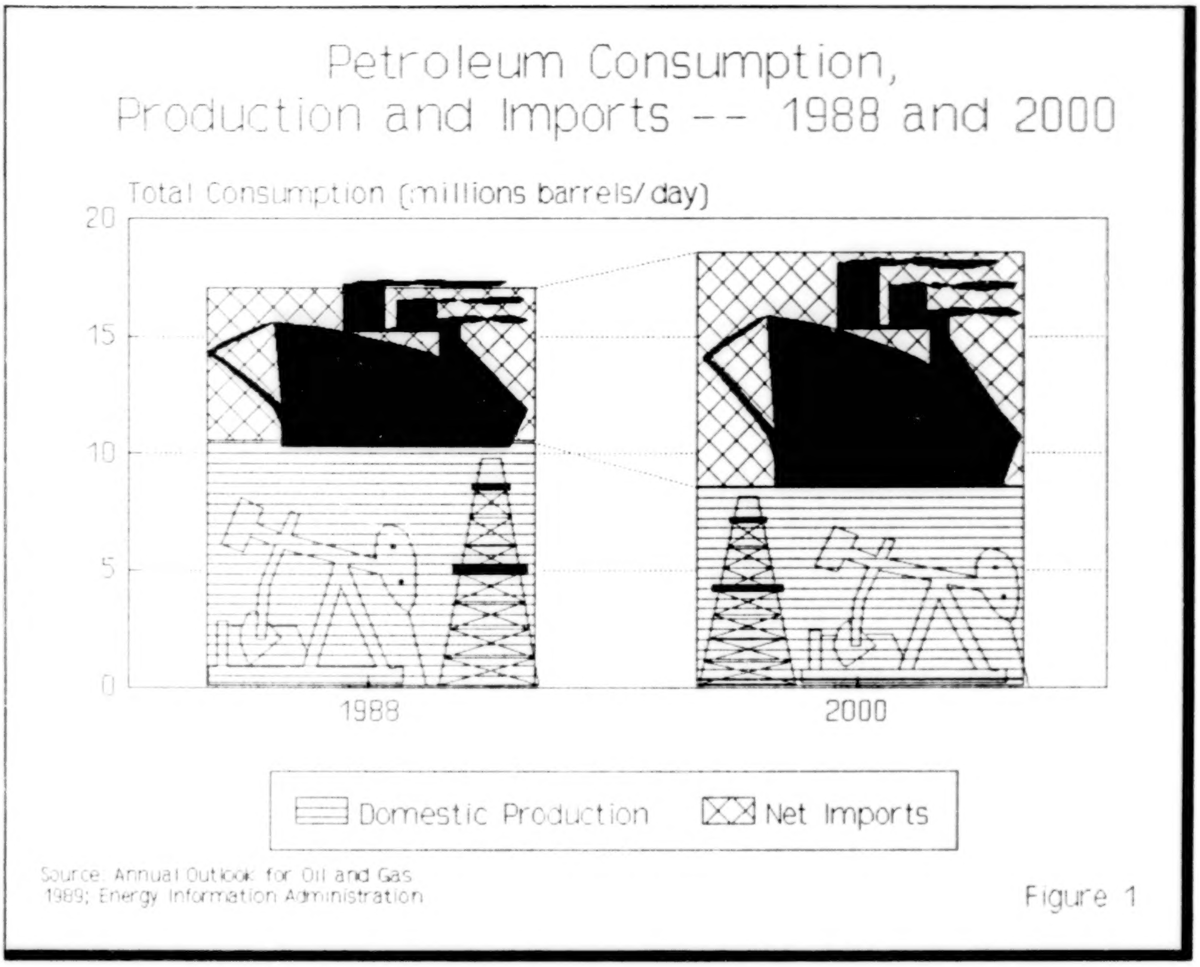
The following sections generally describe current levels and expected trends in petroleum consumption and supply and the network established to meet the Nation's petroleum demand.

Trends in U.S. Petroleum Consumption and Supply

Although current U.S. petroleum consumption remains somewhat below the pre-embargo levels of the early 1970's, petroleum is still the Nation's principal fuel. According to the Energy Information Administration's (EIA) 1989 *Annual Outlook for Oil and Gas*, the base case projection for U.S. petroleum consumption in the year 2000 is 18.5 million barrels per day, up from about 17.3 million barrels per day in 1988. In alternative projections which assume either high world oil prices and low economic growth or low world oil prices and high economic growth, consumption in 2000 could range from 17.5 million barrels per day to 19.9 million barrels per day.

Simultaneously, domestic petroleum production[1] (see endnotes, p. 29) is expected to decline from about 10.5 million barrels per day in 1988 to 8.6 million barrels per day in 2000 according to EIA's base case estimate. In the other projections, estimated production in 2000 ranges from 7.8 to 9.4 million barrels per day.

As domestic demand for petroleum products increases and domestic oil production decreases, the shortfall in supply will be met by increased use of imported crude oil and petroleum products. In EIA's base case forecast, net imports in the year 2000 are estimated at 10.0 million barrels per day, compared with 6.6 million barrels per day in 1988 (total petroleum imports of 7.4 million barrels per day less 800,000 barrels per day of petroleum exports). In the alternative cases net imports range from 8.1 to 12.2 million barrels per day and would constitute



Petroleum Consumption, Production and Imports -- 1988 and 2000

Source: Annual Outlook for Oil and Gas 1989; Energy Information Administration

Figure 1

46 to 61 percent of petroleum products consumed. The widening gap between domestic production and consumption, which must be filled by imported oil in the EIA base case, is presented graphically in figure 1.

The increase in imports will almost certainly mean a corresponding increase in the number of tankers loaded with crude oil and refined products entering U.S. waters. In 1988, about 6.4 million barrels per day[2] of petroleum arrived in tankers averaging about 80,000 dead weight tons[3] (DWT). This amount equates to about 4,000 port calls by tankers. If imports grow to 10.0 million barrels per day in 2000, as in EIA's base case, the result would be about 6,250 portcalls per year, assuming average tanker size remains constant. If imports reach 12.2 million barrels per day, port calls could increase to 7,625 per year, or nearly double the current number. In addition, about 2 million barrels per day of U.S. domestic production, as well as large volumes of petroleum product exports and coastal shipments, enter and leave U.S. ports. Together, oil imports, exports, and domestic shipments will lead to higher volumes of oil moving through U.S. ports.

The increase in port calls may become more significant as either the space available in current harbors is used to capacity, necessitating the construction of new port facilities, or if congestion in crowded harbors increases, therefore increasing the risk of tanker accidents. New port facilities could be constructed in current harbors, increasing congestion, or in areas not currently served by major oil ports, necessitating increases in the amount of shore, harbor, and riverfront land devoted to industrial uses (e.g., oil storage and refineries). Further investigation is needed to determine the amount of additional port capacity that would be required to meet expected increases in U.S. oil consumption and imports.

U.S. Crude Oil and Refined Product Distribution Network

Since the proposal for increased use of offshore oil terminals would require changes to the pattern of U.S. oil imports, exports, and domestic shipping, it must be examined in the context of the overall U.S. petroleum distribution network. This highly complex network, as briefly described below, efficiently supplies the more than 17 million barrels of petroleum products required daily by consumers throughout the country. It also moves the additional 800,000 barrels of crude oil and petroleum products that are exported daily.

Domestic production of roughly 8 million barrels per day of crude oil is delivered to refineries as follows:

- Two million barrels per day of Alaskan oil, most of which crosses the State through the Trans Alaska Pipeline, is delivered by tankers to the lower 48 States. About 75 percent goes to west coast refineries in Seattle, San Francisco, and Los Angeles. The remainder goes to the Gulf and east coast refineries or to refineries in the U.S. Virgin Islands, either by large tankers rounding Cape Horn or by pipeline through Panama, and is then carried to final port destinations by smaller tankers.

- About 3.6 million barrels per day of production in Texas, Louisiana, and Oklahoma (including production from State and Federal waters in the Gulf of Mexico) is transported by pipelines to refineries along the Gulf coast (Houston, New Orleans) and to inland refineries in that producing area, and to refineries in the midwest.

- One million barrels per day of California production (including production offshore California) is transported, mainly by pipelines, to refineries in Los Angeles and San Francisco. About 100,000 barrels per day is transported by pipeline to Texas.

- The remaining 1.4 million barrels per day of U.S. crude oil production is scattered widely throughout the Nation[4] and is transported to refineries by a variety of pipelines, roads, and inland waterways.

Crude oil imports of about 5.1 million barrels per day in 1988 came from locations throughout the world:

- Imports of Canadian oil (about 700,000 barrels per day) arrive mainly by pipeline to midwestern refineries.

- Imported oil from the Middle East (about 1.3 million barrels per day) typically is transported by very large crude carriers (VLCC) or by ultra large crude carriers (ULCC)[5] for most of the voyage. The oil is then transshipped in smaller vessels from Caribbean terminals, lightered[6] to smaller vessels on the high seas, or unloaded at LOOP. According to some estimates, about one-half million barrels per day are lightered on the high seas and moved into the New Orleans area each day, and total high seas lightering in the Gulf of Mexico approaches 1.5 million barrels per day, mostly for delivery to refineries on the Gulf and east coasts. About 800,000 barrels per day is delivered to LOOP, mostly in VLCC's or ULCC's, and then is transported to onshore storage or refining facilities by pipeline.

- Imports from Africa (about 800,000 barrels per day), the North Sea (about 300,000 barrels per day), Mexico (700,000 barrels per day), and South America (about 600,0000 barrels per day, mostly from Venezuela) are transported in relatively small tankers capable of delivering oil directly to east and Gulf coast ports. Some shipments of oil from the North Sea and Africa are imported on VLCC's or ULCC's and are handled in a similar way to the Middle Eastern shipments described above.

- Crude oil imports of about 300,000 barrels per day from the Far East, mainly China and Indonesia, are delivered to Gulf and west coast refineries.

- Another 400,000 barrels of crude oil per day is imported from countries throughout the world to U.S. ports, mostly by tanker.

Petroleum product imports of about 2.3 million barrels per day include heavy fuel oil, naphtha, gasoline, diesel, and other products. These arrive mainly by smaller tankers, which can deliver the products directly to ports serving product distribution centers throughout the Nation. Principal import sources include Venezuela, the Caribbean, Brazil, Europe, and China. At the same time, the United States exports about 700,000 to 800,000 barrels per day of crude oil and refined products, mostly from the gulf and west coasts. Products exported are principally residual fuel oil, petroleum coke, and distillate fuel oil, which are surplus to the regional U.S. markets where they are produced.

FACTORS IN SELECTING POTENTIAL SITES FOR OFFSHORE OIL TERMINALS

If offshore oil terminals are to be constructed, they should be located, when practicable, at sites where use of an existing petroleum distribution network (pipelines, refineries, storage, etc.) can be maximized, therefore minimizing costs and disruption to industry and consumers. Generally, this approach would mean locating the offshore oil terminals near existing ports and harbors, especially those handling the largest volumes of crude oil and petroleum products. Other factors, however, will affect possible offshore oil terminal sites, and must be considered in any site selection process.

The following sections provide information on current oil shipments at U.S. ports and factors affecting site location for offshore oil terminals.

Petroleum Volumes Handled by U.S. Ports

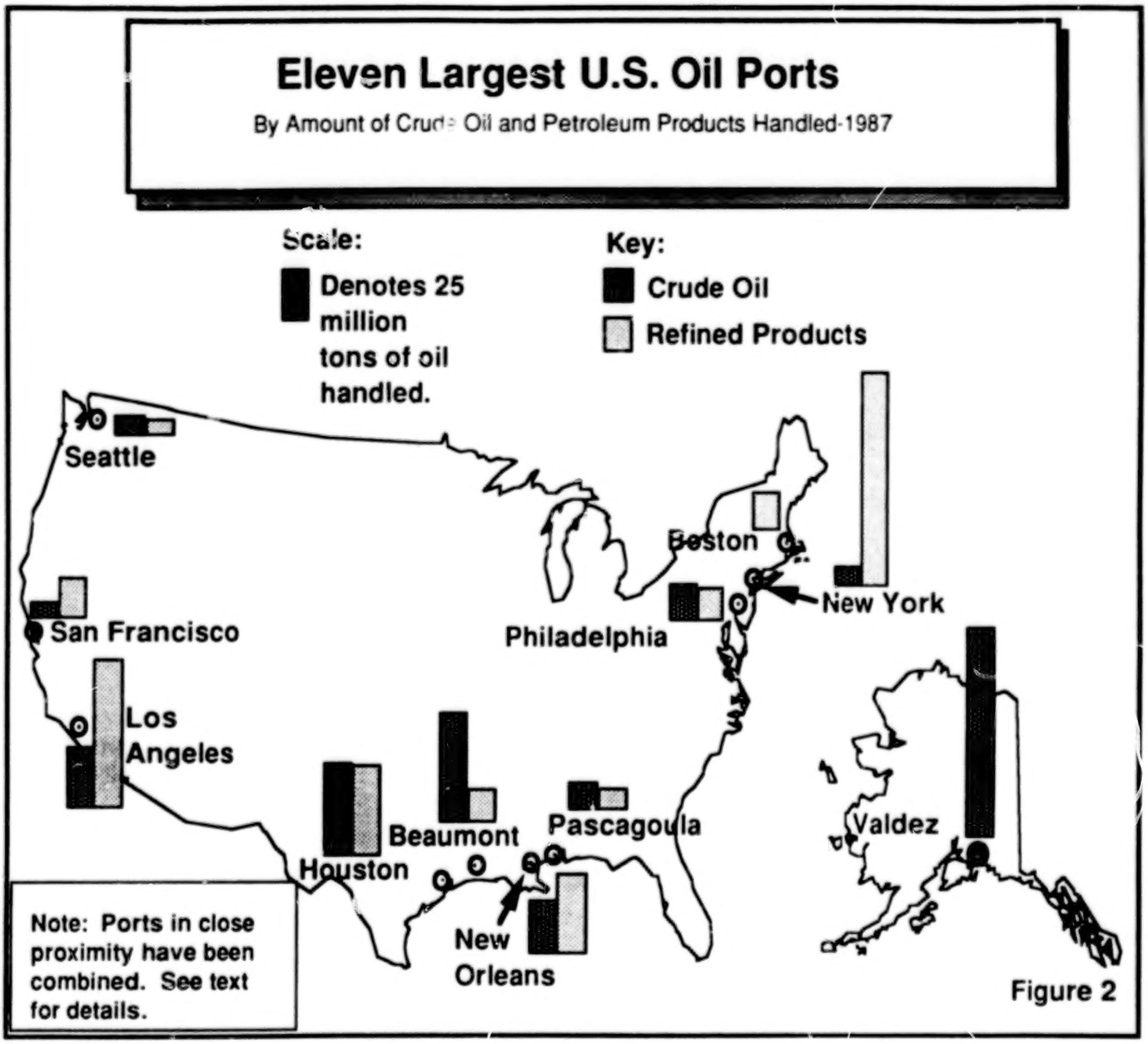
More than four-fifths of U.S. oil shipments by volume are handled by the 11 ports[7] shown in figure 2. (For information on individual ports and volumes handled see appendix I.) Together, they account for 81 percent of the total volume of oil entering or leaving medium-to-large sized harbors in the United States. The data in appendix I, compiled from information provided by the U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center, include the majority of oil handled by U.S. ports.

In addition to the 107 ports listed in Appendix I, a number of smaller ports are equipped to ship or receive oil. According to Maritime Administration data, a total of 173 ports (excluding ports on the Great Lakes) have petroleum storage capacity.

For crude oil, the top 11 ports account for 88 percent of the total U.S. volume. Valdez alone accounts for 28 percent of U.S. crude oil shipments, but that share can be expected to drop with the projected decline in Alaska crude oil production and the projected growth in U.S. petroleum imports. The top six crude oil ports (Los Angeles, Valdez, Houston, Beaumont/Port Arthur, New Orleans, and Philadelphia) account for three-fourths of the total volume of crude oil handled in U.S. ports. The crude oil handled by these six ports alone accounts for one-third of total petroleum (crude and products) handled by U.S. ports.

Considering only refined products, the top 11 U.S. ports account for 75 percent of total U.S. products handled. Six ports (New York, Los Angeles, Houston, New Orleans, San Francisco, and Boston) account for 64 percent of all refined products handled at medium-to-large sized U.S. ports.

The crude oil and petroleum products handled by U.S. ports include both domestic production and imported petroleum. Appendix II provides an overview of petroleum imports and shipments of crude from Alaska to the lower 48 States in 1988. About 3.4 billion barrels of crude and product were shipped into the lower 48 States, Hawaii, Puerto Rico, and the Virgin Islands in 1988. Of that total, crude oil accounted for more than 2.5 billion barrels. Over 20 percent of the crude, 648 million barrels, was shipped from Alaska. Petroleum products accounted for the remainder of the inflow of petroleum in 1988: 426 million barrels of fuel oil; 156 million barrels of ethane, propane, butane, and natural gas liquids; 203 million barrels of motor fuels; 44 million barrels of kerosene and naphtha; 2 million barrels of lubricating oils; and 0.5 million barrels of lubricating greases. Although the principal ports generally handle the largest volume of imports and domestic shipments, smaller volumes of imported crude oil and petroleum products are received at all borders. The data in appendix II are arranged by region, and



Eleven Largest U.S. Oil Ports

By Amount of Crude Oil and Petroleum Products Handled-1987

Note: Ports in close proximity have been combined. See text for details.

Figure 2

within each region by U.S. Customs Service District Office. The data show where shipments were declared for customs purposes, not necessarily the ultimate destination.

The information discussed above only gives an approximate indication of where the majority of U.S. oil shipments occur: the actual pattern of shipments is considerably more complex. One reason for complexity is the variety of crudes and products handled. Crude oil is not a homogenous commodity--there are wide variations in density, viscosity, sulphur content, heavy metal contaminants, and product yields associated with various crudes. Prices for 53 separate crude grades are listed in *Platts Oilgram Price Report*, and many other grades in use are not listed. Furthermore, a large variety of petroleum products are handled by U.S. refiners, ranging from unfinished products used as feedstocks and blending components to a wide array of intermediate and final products shipped out to consumers, other refiners, and petrochemical processors.

In order to replace the highly flexible network of tanker and barge transportation with a pipeline system serving offshore oil terminals, it is necessary to be able to segregate different crude oil and product streams from one another. Some crudes and products require special pipelines (e.g., heated lines). The pipeline system should be capable of delivering the appropriate crude or product to or from the appropriate refinery when necessary.

For example, the pipeline system required for the crude oil delivery system in the vicinity of the port of New Orleans is quite complex. Five refineries in the New Orleans area are served directly by tanker, as well as by pipeline from three marine terminals, including LOOP. In addition, pipelines carrying oil from offshore production platforms enter the St. James terminal, located on the Mississippi River between New Orleans and Baton Rouge for distribution. About 750,000 barrels of crude oil leave the St. James terminal daily via the Capline pipeline to refineries in the midwest.

The 11 largest U.S. ports are potential sites for large offshore oil terminals. If tanker and barge traffic is to be entirely eliminated from coastal areas, these ports could be used to serve the needs of entire geographic regions (e.g., a facility in Boston could handle all the shipments for New England). The 11 ports could serve all of the coastal regions in the conterminous United States except for the southern Atlantic coast. However, each region contains a large number of smaller ports that handle petroleum (see appendix I). Building a regional facility to replace these ports would require rebuilding the onshore storage and transportation infrastructure in order to connect all of these sites to the offshore terminal.

Alternatively, the larger ports could serve only the immediate vicinity, for which the distribution network already exists, and small offshore facilities (such as single mooring points) could be built off each of the small and medium-sized ports. The tradeoff in considering the optimal investment for each area is the cost of building an offshore terminal versus the cost of the additional pipelines and storage needed to connect the area to a larger facility. If the objective is to reduce, rather than eliminate, tanker and barge traffic, offshore oil terminal facilities could be limited to the largest ports, while oil tankers and barges continue to use the smaller ports.

Siting Considerations

Several factors must be considered when evaluating sites for offshore oil terminals.

Water Depth - No harbor-based ports in the United States are capable of handling fully loaded ULCC-class tankers that transport oil at considerable savings per ton over smaller tankers. Any new offshore terminals that may handle large quantities of crude oil should be capable of handling these vessels. To accommodate ULCC's, the port would have to be situated in no less than 110 feet of water. To accommodate smaller tankers (about 40,000 DWT) and barges in small ports that handle mostly petroleum products, the port could be located in water depths of about 45 feet.

Physical Oceanography - Ocean currents such as the Gulf Stream or circulation patterns may cause some potential sites for offshore oil terminals to be unsuitable.

Water Temperature - Various grades of petroleum begin to flow at different temperatures, known as the pour point. Heavier grades of crude oil and refined products are too viscous to flow at the temperatures often prevailing in the marine environment. These oils may require heating to keep their temperatures above the pour point or mixing with a viscosity reducer in order to pump them through a subsea pipeline.

Geological Constraints - Some potential offshore oil terminal sites may be in areas subject to seismic or volcanic activity or sediment instability, which could damage permanent structures and pipelines.

Proximity to Existing Pipelines - To control total distribution network costs and to limit the effects of onshore dislocations, offshore terminal facilities should be located where they make maximum use of existing distribution networks. This approach would minimize the amount of additional pipeline that must be laid, while assuring continual supply of specific crude grades to specific refineries. The scheduling and sizing of the existing network are quite complex. For example, although LOOP is currently operating at less than 60 percent of its capacity, one major Louisiana refiner currently must use direct tanker delivery to its refineries when pipeline commitments will not allow transport from LOOP at the required times.

Existing Commercial and Military Shipping Safety Fairways - The Coast Guard has established commercial shipping fairways of varying widths along the Atlantic, Pacific and Gulf coasts, and entering and leaving major and minor ports. Similarly, military fairways have been established for surface and submarine naval traffic in proximity to naval bases. The siting of terminal facilities would have to avoid these fairways to decrease the chance of collision. Terminals must be proximate to the commercial fairways, however, to give the tankers a safe route to port.

NASA and Military Flight Areas - The National Aeronautics and Space Administration (NASA) has established restricted areas in proximity to their Cape Canaveral, Florida and Wallops Island, Virginia facilities. In addition, Navy and Air Force missile and bombing ranges off the coasts of California, Virginia, and Florida must be avoided in offshore oil terminal siting.

Multiple Use - Many potential sites for offshore oil terminals to serve existing refinery complexes could conflict with other uses of the ocean or coastal zone, including fishing, recreation, oil and gas exploration and development activities, and marine mining.

Effects on Endangered Species and Marine Mammals - The effects of offshore oil terminal siting on the alongshore migration patterns of endangered species such as turtles and whales would have to be considered.

Effects on Wetlands from Additional Pipelines - Wetlands loss is a major concern throughout the country, but particularly to the States of Alabama and Louisiana. Construction of petroleum pipelines through these areas increases wetland exposure to erosion, which contributes to their destruction. Siting of pipeline landfalls and additions to the onshore distribution network must consider the effects on wetlands.

OFFSHORE OIL TERMINALS: REGULATORY BACKGROUND

Beginning in the late 1960's, it was widely believed that increasing imports would eventually necessitate transporting oil in larger, more efficient tankers, and would require construction and expansion of U.S. ports. The depth of channels at current harbor-based ports in the United States limits the size of the tankers they can handle. Most ports in the United States, including New York, the Nation's busiest, are limited to handling oil tankers of about 80,000 DWT. This limit precludes U.S. oil importers from reaping the benefits of using larger tankers to transport oil directly from oil-exporting countries to the U.S. ports where the oil is needed.

Although a number of plans for constructing "superports" at major petroleum ports to handle the expected increase in oil imports were proposed, only the LOOP facility was constructed. The pressure to construct offshore oil terminals capable of handling the largest tankers was reduced by: (1) the ability of shippers to transship by docking in Caribbean ports and loading on to smaller tankers; (2) the practice of lightering crude oil and petroleum products in the Gulf; and (3) decreases in oil imports from the Middle East during the early 1980's resulting from reduced energy consumption.

When construction of the superports was proposed, a number of groups raised environmental and economic objections. Some groups opposed their construction because they feared the superports would lead to the development of new onshore storage and refining facilities, as well as adverse environmental impacts in the areas to be served by the ports. There was also concern that the ports would disrupt operations and reduce employment at existing harbors. Consequently, Congress enacted the Deepwater Port Act of 1974 (33 U.S.C. 1501-1524) to provide deepwater port licensing procedures and requirements.

In order for construction to proceed, a deepwater port must conform to the requirements of a number of Federal, State and local laws. A Federal license from the Department of Transportation (DOT) under the Deepwater Port Act is required to construct the offshore terminal, and Department of the Interior (DOI), Corps of Engineers and state permits are required to construct ancillary port facilities such as pipelines and storage tanks.

The Deepwater Port Act of 1974 empowers the Secretary of Transportation to license and regulate deepwater ports beyond the territorial sea of the United States.[8] Private parties or governmental entities may propose ports in deep water. Applications must include sufficient information to allow the Secretary of Transportation to judge whether the port will comply with all technical, environmental, and economic criteria. Once a license is issued, it remains in effect unless terminated by the licensee or suspended by the Secretary of Transportation.

Regulations provide for extensive consultations among all interested Federal agencies, any potentially affected coastal State, and the general public. Adjacent coastal States are granted an effective power of reservation over proposed projects. Under the statute, if a Governor of an adjacent coastal State notifies the Secretary of Transportation that a proposal is inconsistent with State programs relating to environmental protection, land and water use, and coastal zone management, then the

Secretary shall grant the license on the condition that the proposal is made consistent with such State programs. Governors may also reject the proposed projects on other grounds.

In addition, the Attorney General of the United States and the Federal Trade Commission must review any application for its effects on competition. The Act requires all deepwater ports and related storage facilities to be operated as common carriers, unless the licensee is subject to effective competition.

As there have been no proposals for the past 7 years, the agency within DOT that regulated offshore ports has been dissolved. A similar agency must be established if new deepwater ports are to be considered.

The Act contains extensive incentives to prevent oil spills by providing strict liability, without the need to prove fault, for all damages caused by any oil spill. The Act limits the damages to a maximum of $150 per ton or $20 million, whichever is less, from the owner or operator of a vessel, plus up to $50 million[9] from the licensee of the port. In addition, the licensee or the owner or operator of a vessel that discharges oil into the marine environment will be assessed a civil penalty of up to $10,000 for each violation. These liability limits are likely to be raised by legislation currently pending in Congress.

The Act also establishes a $100 million liability fund to pay for all cleanup costs and damages incurred in excess of the liability limits. Moneys for the fund are generated by a 2 cents per barrel tax on all oil (except for bunker or fuel oil to be used on the ships and oil transported through the Trans Alaska Pipeline) loaded or unloaded at licensed facilities.

DESIGN AND COST OF OFFSHORE OIL TERMINALS

The factors and constraints that determine the desired operating characteristics of an offshore oil terminal must be clearly analyzed and defined in the planning stage. Some of the more significant factors include: throughput capacity, distance from shore, design of vessels, conditions limiting navigation, conditions that limit operations, number of berths, seabed conditions, types of products, and vessel servicing and bunkering requirements. Each of these factors will affect both the costs of constructing and operating the facilities.

Design Considerations

Once the desired operating characteristics of the terminal have been established, the criteria for the terminal design must be determined. The structural standards and codes for the design must be defined, and safety guidelines as well must be established. In addition to the design of the structure, aspects such as approach channels and vessel maneuvering areas must be carefully considered.

Although domestic experience with offshore oil terminals is limited to the LOOP facility in the Gulf of Mexico, considerable international experience[10] has contributed to the development of several major designs and knowledge of their primary operational features, as described below.

Fixed berth (one-sided or two-sided sea island)

- Berthing requires waves less than 6 feet and winds under 24 knots. Unloading requires winds below 37 knots. Currents need to run parallel to the berth axis.

- If these conditions are not met, expensive breakwaters are required. Consequently, recent proposals for this type of terminal have placed the sea island behind existing breakwaters (Pacific Texas Pipeline Co. project in Los Angeles harbor) or have made use of a natural shelter (Point Tupper Ocean Terminal in the Strait of Canso, Canada).

Single point mooring (SPM)

- Single point mooring is used at the majority of offshore terminals. Typically, a single buoy is anchored to piles by chains. Unloading hoses are equipped to float and must be snared and raised to the manifold by the ship's gear. Oil is unloaded using the ship's pumps.

- Docking can be accomplished in up to 8-foot seas and tankers may be unloaded in up to 12-to-15 foot seas.

- The buoy and unloading hoses are fastened to a rotating swivel assembly. This design allows the ship to orient itself into changing currents since the swivel permits 360 degree rotation.

- This design is especially suitable where rotary tidal stream patterns or sudden changes in wind direction are prevalent.

Disadvantages of this design include:

- Tankers tend to creep toward mooring in calm conditions, which may damage the mooring.

- Floating hoses may be damaged by vessels and/or waves.

- The underwater portion of the hoses may be damaged by buoy shifting in rough seas.

- The hoses must be replaced regularly, requiring an average of one day per month down-time. Buoy should be dry-docked every 3-5 years (one month down-time) for major reconditioning.

Conventional buoy mooring

- In conventional buoy mooring, tankers are moored to a number of buoys at the bow and stern, thus fixing the orientation of the ship. Petroleum cargoes are loaded or unloaded through hoses.

- Docking maneuvers may be complex, involving setting of anchors and the use of the ships' engines to turn the vessel into a mooring position. If a rotary tidal stream is present, the difficulty in executing these maneuvers is greatly increased.

- Ships are held in position over the submarine manifold by a combination of the ships' anchors and the mooring buoys. Because orientation of the ships is fixed, ships do not weathervane (swing with changes in the current) and consequently, exhibit large motions under heavy broadside or quartering sea conditions, limiting the facilities' use during such conditions.

Single pile mooring

- Single pile mooring is similar to single point mooring, except that the buoy anchored to the sea floor, is replaced by a solid or truss structure, which either rests on the sea floor through the use of a gravity base or is held in place by a foundation below the sea floor.

- The ship is connected to the pile or truss tower by hinged floating booms. Since the boom is not flexible in all orientations, the design of the booms is critical due to stresses from winds and currents as the ship rotates about the mooring.

- This design eliminates some of the disadvantages created by the structural flexibility of single point moorings.

- The major drawback to this design is cost. Construction of the offshore facility, exclusive of pipeline, storage, etc., for this design is two to five times as expensive as the single point mooring system.

Construction Costs

Construction costs for offshore oil terminals may vary significantly as site-specific design factors are identified. Therefore, several scenarios with associated cost estimates were prepared (appendix III). Cost estimates range from $69 million for a single buoy system that can unload 400,000 barrels a day in a relatively sheltered environment in 125 feet of water, to $1.5 billion for a multiple berth facility designed to unload 1.6 million barrels a day at a location 32 miles offshore in 120 feet of water. The cost of pipelines and storage is the most expensive and problematical part of trying to site and construct offshore port facilities about the Nation's coastline. Analogies can be developed for additional areas of the country by using appendix III and the following guidelines.

Port Construction - The choice of port design is dictated by consideration of site specific engineering, environmental, and economic factors. Consulting engineering firms currently active in petroleum terminal design agree that for the majority of locations a single point mooring system with pipelines to onshore storage represents the optimization of these factors. Each single point mooring berth costs about $10 million.

If platforms are required to support pumping equipment and living quarters, fabrication and installation costs in 120 feet of water would be about $18 million in the Gulf of Mexico, $21 million in the Atlantic, and $25 million in Alaska. An offshore oil terminal would have to be sited in about 500 feet of water off the coast of California near Los Angeles to maintain a 5-mile safety zone due to the steep gradient of the continental shelf. This requirement would increase platform costs to between $77 million (foreign construction) and $92 million (domestic construction).

Pumping capacity is determined from petroleum characteristics and desired throughput. Typically between six and eight thousand horsepower are required at a cost of about $10 to $13 million. The number of intermediate pumping stations needed depends upon the size and length of the pipeline and the characteristics of the crude oil or product, such as viscosity.

Pipelines - Pipeline costs increase with water depth, pipe diameter, and distance. Construction costs for 48 inches of weight coated pipe, buried 3 feet, are estimated at $1.8 million per mile in the Gulf of Mexico, $2 million per mile for the east and west coasts, and $2.3 million per mile in Prince William Sound.

Storage - As discussed above, tankers cannot dock at single point mooring terminals when wave heights exceed 8 feet. Once tankers are moored, unloading must be discontinued if wave heights reach the 12-to-15 foot range. Since refineries require an uninterrupted stream of raw material, adequate storage must be built to supply the refineries when tankers cannot unload due to adverse sea conditions. The availability of storage for between 7 days (for sheltered environments such as the Santa Barbara Channel) and 14 days (for severe environments such as the North Atlantic) is therefore an integral part of any offshore oil terminal proposal.[11]

Above ground tank-storage construction costs for the lower 48 States are approximately $12 million for every million barrels of storage. In some parts of the country, land acquisition costs, permitting, and rights-of-way represent significant additional expenses. In attempting to site storage facilities in some parts of the country, such as the northeast, it will be very difficult to acquire a large tract of land that is near the coast but away from heavily populated areas where public opposition to such projects may be great. The Department of Energy estimated in April 1989 that above ground storage costs, including land acquisition, permits, and rights-of-way, in New Jersey would approach $15 million for every 1 million barrels of storage. In other parts of the country such as Louisiana, where below ground storage is available in salt domes, as used by the

Department of Energy and LOOP, costs are significantly less. In 1979-1980, LOOP paid approximately $7.5 million for each million barrels of storage in its Clovelly, Louisiana saltdome complex, including leaching, pumps, pipes and valves, and brine storage. The Department of Energy recently estimated that new salt dome development for the Strategic Petroleum Reserve would cost between $5.00 and $7.50 for each barrel contained in a 100-150 million barrel storage site.

Other below ground storage options exist. Under certain conditions, mined storage can be created in suitable shale, limestone, siltstone, or granite formations. There are 73 mined storage sites in use in this country, ranging in size from 60,000 to 1,550,000 barrels in capacity. Although domestic use has been exclusively for the storage of natural gas liquids under pressure, mined storage has been used for crude oil and petroleum storage in Sweden and other countries. Costs to construct this storage are optimized when large volumes can be located at relatively shallow depths. For example, construction of a cavern capable of holding 1-2 million barrels located 400-500 feet below surface is estimated to cost about $16 per barrel. Surface infrastructure (pumps, pipes, etc.) would add $1.50 per barrel for a total of $17.50 per barrel, exclusive of land acquisition costs. To illustrate the impact of storage depth, a recent proposal to locate 2 million barrels of storage at a depth of 2,500 feet near John F. Kennedy Airport in New York is estimated to cost $60 per barrel.

One engineering firm suggested to the Department of Energy that shallow, below ground storage (resembling roofed aqueducts) could be constructed, using trench digging equipment and cast concrete, could be constructed for $9 to $10 per barrel, exclusive of infrastructure or land acquisition. The Department of Energy cautions, however, that "lacking U.S. experience with this storage method, cost and development schedules are highly uncertain at this time."

Operating Costs

LOOP officials indicated that current fees charged shippers ($5,000 per mooring hour and $0.185 per barrel throughput) closely approximate operating costs. The total fee (mooring charge plus throughput charge) currently ranges between $0.29 and $0.33 per barrel, averaging $0.32 per barrel. Current throughput is 800,000 barrels per day (57 percent of capacity under optimum conditions), so operating expenses approximate $256,000 per day or $93.44 million per year in 1989 dollars. LOOP is the only deepwater port operating in the United States. Operating costs for foreign offshore oil terminals were not available. Operating life of the facility, based on designed cathodic protection for the platform, is 30 years. The pipeline is estimated to have a 20-to-30-year life, so the entire facility will need to be replaced at that time.

Although not a high-volume, deep-water port, the Hawaiian Independent Refinery, Inc. (HIRI) facility, located 1.5 miles off Oahu, Hawaii, may be an appropriate model for low volume ports. Tankers call at HIRI once every 7-10 days and average 80,000 DWT in size. The HIRI facility is a relatively simple operation (a single point mooring buoy 1.5 miles from the refinery, requiring no booster pumps, platforms or separate storage) that costs $0.034 per barrel to operate. According to HIRI officials, HIRI plans to initiate the precautionary booming of tankers to contain spilled oil. They estimate this will add about $0.12 per barrel to operating costs.

Storage related operating and maintenance costs vary considerably among locations and types of storage. One engineering firm estimated annual operating costs of conventional steel tank storage to be $0.16 per barrel, whereas the Department of Energy has cited $0.115 per barrel annual operating costs for its 26 million barrel Sulphur Mines facility. One operator of propane cavern storage estimated operating costs of $0.18-0.20 cents per barrel for facilities larger than a 500,000 barrel capacity. Annual maintenance costs for cavern storage were estimated at $0.09 per barrel of capacity, achieving a savings over steel tank storage (estimated at 12.5 cents per barrel) since paint and cathodic protection are not required.

Other costs not directly associated with the operation of the facility, such as modifications to tankers, must also be considered. Offshore oil terminals are designed for, and take advantage of, the economies of scale offered by VLCC and ULCC vessels. Imports from Venezuela, Mexico, and the North Sea, however, typically arrive on smaller vessels that can use existing harbor facilities or unload at LOOP. Requiring all of these vessels to use offshore oil terminals such as LOOP will increase the ratio of operating costs to throughput since they take as long to dock and undock as VLCC's or ULCC's and possess lower pumping capacities. One modification that would improve the economic efficiency of requiring small crude carriers to use offshore oil terminals would be the installation of high capacity pumps on these tankers to reduce offloading time.

FACTORS IN EVALUATING THE FEASIBILITY OF OFFSHORE OIL TERMINALS

In evaluating the feasibility of offshore oil terminals replacing nearshore and harbor-based facilities, the potential benefits must be compared with the large construction and operating costs. In addition, other less quantifiable factors associated with offshore oil terminals must be considered when evaluating their potential. These aspects are discussed below.

Oil Spills and Environmental Factors

A significant potential benefit from offshore oil terminals is a possible reduction in the number of, and damages from, oil spills. The National Research Council (1985) studied the sources of oil pollution in the ocean, and their best estimate was that ocean transportation was responsible for about 46 percent of petroleum in the sea, with tanker accidents accounting for roughly 12.5 percent of total oil pollution (see following table 1). Most tanker accidents, as well as much of the other oil pollution coming from the transportation system, occur in nearshore environments. Damages from these spills can include fouled shorelines, loss of wildlife, reduced commercial fishing harvests, and decreased tourism and recreation. Some of the ways in which offshore oil terminals may reduce spill risks include:

- New facilities can be designed to use the most current environmental control safeguards and technology that could only be instituted at existing facilities through major overhaul.

- Offshore oil terminals would diminish the potential for harbor accidents, such as collisions and groundings, by reducing traffic density in constricted harbors such as New Orleans, Houston, New York Los Angeles-Long Beach, and the Delaware River.

Table 1

Sources of Oil Pollution in Marine Environments

Source	Percentage
Transportation	45.9
Tanker Operations	21.9
Tanker Accidents	12.5
Bilge and Fuel Oils	9.4
Dry-docking	0.9
Non-tanker Accidents	0.6
Marine Terminals	0.6
Municipal and Industrial Wastes	31.9
Atmosphere	9.4
Natural Sources	7.8
Urban and River Runoff	5.0
Offshore Production	1.6

Numbers do not add to 100% due to rounding.

Derived from best estimates contained in National Research Council, 1985, Oil in the Sea: Inputs, Fates, and Effects.

- New offshore facilities can be sited safe distances from ecologically sensitive areas and areas with navigational hazards, again offering the potential to reduce the damage from oil tanker spills.

- Offshore oil terminals would reduce the volume of oil lightered, thereby reducing the amount of oil spilled during this process. The actual volume of oil lost during lightering operations is unknown, since the process is generally unregulated.

- Offshore oil terminals would reduce impacts to the coastal zone caused by small, systemic spills which occur during nearshore transfer operations. The LOOP's record in preventing spills has been exceptional, losing only 815 barrels in 9 years of operation (less than .000056 percent of oil transported).

- New offshore facilities could be required, as LOOP is, to maintain oil spill containment and cleanup equipment onsite and to practice oil spill cleanup drills. If any future offshore oil terminals were subject to the same requirements as LOOP, the terminals would be safer than lightering operations because tankers generally do not have containment or cleanup gear onboard. In addition, the offshore terminals would be safer than current ports, which generally have minimal containment and cleanup equipment onsite. Even if the harbors do have such equipment, spills are more likely to cause damage, due to the harbors' proximity to ecologically sensitive coastlines.

However, not all the potential impacts associated with offshore oil terminals are beneficial and some may pose a hazard to the environment.

- The weather and oceanographic conditions at an offshore terminal will, in many cases, tend to be harsher than in protected harbors. Therefore, the risks of weather-related accidents during docking and transfer operations could be higher.

- Boom and skimmer technology for containing and removing oil spills is less effective in open water than in confined harbors.

- Since offshore oil terminals encourage the use of larger vessels, there would be a potential for spills of greater magnitude.

- Offshore pipelines may need to be laid in environmentally sensitive areas, possibly causing damage to the sea bottom and wetlands. This possibility can be minimized by suitable siting constraints.

- Although burial of pipelines below 3 feet of cover would be required, pipelines between offshore oil terminals and onshore facilities would not be immune to damage, especially from large ships with dragging anchors.

How much these factors associated with the use of offshore oil terminals could either reduce or increase oil spill risks is difficult to quantify. Consequently, a conclusion about whether or not the use of offshore oil terminals could reduce the risk associated with oil shipping operations cannot be made without substantial further analysis. To make such an overall risk assessment, additional data on oil spill rates and corresponding regulatory procedures at offshore oil terminals in use around the world must be analyzed. If such data can be obtained, the specific environmental and operating characteristics of likely U.S. offshore oil terminals, including their design and location, and how they differ from conditions at current U.S. ports and worldwide offshore oil terminals, would have to be factored into the analysis.

Economic Factors

Perhaps the most significant potential economic benefit of offshore oil terminals is reduced transportation costs. Savings associated with these facilities will depend on the relative sizes of the ships being compared, the length of haul, and market conditions (tanker capacity utilization) during the period in question. In general, for long hauls, savings are achieved from shipping in larger ships.

During the 1970's, several studies estimated transportation cost savings by comparing the estimated cost of transporting oil in VLCC's from the Middle East to deep-water ports with the cost of transporting the oil from the Middle East to gulf and east coast ports in smaller tankers. A draft Department of the Interior environmental impact statement estimated a savings of $0.33 per barrel, and a LOOP study estimated a savings of $0.19 per barrel comparing transport in a VLCC with transport in an 80,000 DWT tanker.

These estimates may have overestimated the potential savings since most imported Persian Gulf oil is not transported the entire distance on the smaller tankers. Rather, much of the oil arrives in this hemisphere aboard VLCC's and is transshipped in Caribbean ports or lightered from anchored vessels in the Gulf of Mexico for delivery to Gulf and east coast ports by small tankers. Thus, the transportation savings associated with deepwater ports would be limited to the lower transportation costs achieved over the short distance from the Caribbean ports or the Gulf of Mexico lightering point to the U.S. ports (rather than the entire distance from the Persian Gulf to the United States) plus the elimination of lightering or transshipment costs.

Other Impacts

Socioeconomic - Some impacts that may result from construction and operation of the ports are less certain and also will require further assessment. Owners of current port facilities have expressed concern that their capital investment would become less valuable if an offshore oil terminal strategy is implemented. Offshore oil terminals are likely to follow the example of LOOP in the use of extensive automation. The number of workers employed at existing port facilities is likely to be greater than those required to operate offshore oil terminals. The number of workers that can be re-assigned to a new offshore facility would depend on the number of positions available and on the previous workers' suitability for retraining and their willingness to relocate.

A major impetus for the interest in offshore oil terminals in the 1970's was to promote the economic development of port regions. In particular, facilities were designed to handle VLCC's in order to support existing or planned refineries in these regions, which would benefit from the reduced transportation cost of imported crude. Construction of offshore oil terminals in the United States could serve as a magnet for additions to refining and petrochemical capacities. Some companies could choose to expand capacity near the large offshore oil terminals at the expense of facilities that are inland or near smaller ports. In addition, smaller refiners that are not favorably located with respect to the terminals could suffer.

The economic advantages of transporting petroleum to offshore oil terminals with VLCC's are more significant for crude oil than refined products, because VLCC's are generally not used for transporting refined products. This factor provides a further impetus for constructing additional refining capacity near offshore oil terminals and could result in a change in the relative share of imports from refined products to crude oil.

Any addition to the onshore industrial base, as well as the need for large tank farms tied to the offshore oil terminals, would result in greater employment among the refining and distribution sector and, thus, a larger economic base. Increases in the scale of petroleum and petrochemical industries have also been associated with increased local air and water pollutant emissions.

National Security - Concentrating all crude oil and product imports, and perhaps a large percentage of the interstate movement as well, in a relatively few, easily identifiable offshore terminals may increase the risks both of a wartime quarantine of the United States and of terrorist attack. Since concentration of facilities creates the potential for reduced security, consultation with the Department of Defense is needed before any formal proposal is made.

FUNDING

A major reason for the lack of interest in constructing new offshore terminals has been LOOP's failure to earn a return on investment for its owners. Only in recent years has LOOP even been able to meet its operating budget from the fees that it charges. Therefore, without some form of government encouragement, offshore oil terminals will attract little interest from private investors.

Although it is still uncertain at this stage of study, whether there are significant enough benefits attributable to increased safety and reduced environmental risks to overcome the potential hazards and costs of these facilities, this section gives an overview of some of the possible funding measures that the government could employ to encourage their use.

Indirect Incentives

Prohibition of Crude Carriers near shore - If tankers (or only crude carriers) were prohibited by Federal law and regulations from docking within 5 miles of shore, then, because of their local monopoly on the importation of petroleum, use of the offshore oil terminals would increase and they would become economic. For example, if transportation of (crude) oil were prohibited to and from the ports of New Orleans and Baton Rouge, LOOP would be the only source of imported and Alaskan crude oil for this important region. LOOP currently has operating costs that are less than $0.01 per gallon. If the entire 1.4 million barrels per day of crude oil traffic in New Orleans were shipped through LOOP, LOOP's capital costs could be amortized by a small charge. Adding a competitive return on capital would still keep the total costs charged to LOOP's customers in the order of $0.02 per gallon.

On the other hand, if Federal regulations discouraged competition in this way, offshore terminals would then be subject to the Deepwater Port Act provisions which discourage the licencing of monopoly ports. The ports are likely to be monopolies as it would be exceedingly costly in terms of actual capital outlays and in terms of environmental degradation (due to duplicate pipelines) to have more than one offshore port serving the same refineries in any one area. In that case amounts charged by the terminals would only be limited by the underlying demand for the crude oil.

If a prohibition on crude carriers nearshore were adopted, two amendments to the Deepwater Port Act might be required: first, an amendment that allows monopolistic ports (otherwise none would survive review), second, if monopolistic facilities are to be sanctioned by law, they should be regulated to limit the prices they can charge.

Fees based on Use - Currently shippers continue to use the Port of New Orleans rather than LOOP for two reasons. First, the port offers the convenience of docking at the refinery or other facility which is the ultimate destination of the petroleum, decreasing the need to time shipments as carefully, considering delays in the complex pipeline/storage system associated with LOOP. In addition, the port may offer lower total costs than those associated with LOOP. Generally the port will be fully depreciated, and there will be no costs for operating pumping stations or excess storage associated with the offshore facility.

If the government determines that it needs to encourage the construction of offshore oil terminals, it may charge tankers a fee for the use of onshore ports, which would eliminate the cost differential between the two types of facilities. The increased risks and costs associated with oil spills in harbors as compared with spills at offshore facilities could be cited as justification for such a fee.

Government Funding

Direct government subsidies could be used to encourage the construction and use of offshore oil terminals. These subsidies could be in the form of: tax incentives, government loan guarantees, or appropriations. The conditions that justify the types of indirect inducements described above could also be used to support direct subsidies. If there are sufficient environmental benefits to offshore oil terminals, then there may be sufficient public good to spend public monies. Since the amount of subsidy needed will depend on the overall economics of the proposal, this section does not provide any specific amounts. Rather, these three methods of subsidy are discussed generally.

Tax Incentives - A tax incentive program could be of two basic types: capital cost acceleration or current expense allowances. Offshore oil terminals are complex, long-lived capital intensive facilities. Investment in them could be increased by accelerating the capital cost recovery or by providing an appropriate investment credit. If these allowances are considered, any deductions must be available to the actual investor (usually an oil company), since the consortium that actually owns the facility can be presumed to operate at a loss.

Current expense allowances may be closely tailored to the desired goals. For example, a deduction could be allowed for the costs of purchasing oil-spill containment equipment (normally a depreciable asset). Alternatively, operating losses, perhaps including capital expenses, could be passed through to the owner(s) regardless of the corporate structure of the consortium/joint venture.

Loan Guarantees - The capital costs of these facilities are substantial and if they are not expected to be profitable, it may be difficult to procure outside financing without risking the capital base of the owner corporations. By providing loan guarantees, the government in essence underwrites all losses up to the value of the guarantee. If this method of subsidy is used, the guarantees should contain provisions to ensure that the terminal owners have the incentive to minimize any losses.

Appropriations - The most straightforward method of encouraging a private party to undertake a government sanctioned activity is to pay for it. There are two possibilities: operating subsidies and capital grants. The policy variables here include not only the amount of the award, but also the percentage of costs to be subsidized and the incentives to insure that costs are kept to a minimum.

ACTIONS TO REDUCE THE RISK OF OIL TANKER SPILLS

The focus of this report is offshore oil terminals, but several other options have been proposed for reducing oil tanker accidents. This section provides a brief overview of the most commonly mentioned proposals.

Stricter Regulation

Require foreign tankers using U.S. ports meet the same standards required of U.S. tankers. - Standards set by the Department of Transportation for U.S. tankers are often stricter than those of other countries, particularly the "flag-of-convenience" countries. Regulations might address such areas as safety features in the ship, training, and manning requirements. Requiring that all tankers using U.S. ports adhere to stricter standards could reduce the risk of spills from foreign tankers in U.S. waters. As with any regulatory solution, the key to success will be vigorous enforcement and large penalties for violations. The incentive to comply with the regulations arises from the belief that violators will be identified and penalized.

Require local pilots on all tankers within the territorial sea. - Many port authorities require local pilots on board all incoming or outgoing vessels in the approaches to the harbor. However, harbors are not uniform in this requirement. In some cases, local pilots are not required for the full length of the critical passage (as with the *Exxon Valdez*, which had already dropped off its pilot), and in other cases, the requirements are ignored (as with the *World Prodigy* spill off Rhode Island, where the tanker failed to pick up a pilot). Requiring licensed pilots who are familiar with local navigation hazards and practices to be at the helm could reduce the risks of accidental groundings or collisions. Requiring local pilots to remain on board farther out to sea, perhaps as far as the boundary of the territorial sea, would reduce the risks still further. Again, enforcement and penalties must be sufficient to insure compliance.

Require double hulls on tankers using U.S. ports. - This option was considered in the 1970's during the Trans Alaska Pipeline debates and has been considered again in legislation introduced in Congress in response to the oil spills in spring 1989. The double hull is designed to reduce the risk of spills by providing enough space between the hulls so that the inner hull would not be penetrated if the outer hull is breached. A Coast Guard analysis indicated that the volume spilled from the *Exxon Valdez* could have been reduced by 60 percent, and the other 40 percent of the oil would have spilled at a slower rate, had the *Valdez* been built with a double hull. The Coast Guard also noted, however, that such a design could have resulted in an even larger spill had there been a collision between ships. Other critics of the proposal have noted that double hulls can make it more difficult to refloat the ship after a grounding due to the water trapped between hulls, thus making spill cleanup more difficult.

Require increased radar coverage in coastal areas. - Currently, the Coast Guard monitors ships within specified distances of some port facilities on radar and directs them to change course to avoid potential hazards. The systems are not comprehensive, however. For instance, although the *Exxon Valdez* was still within range of radar, it was past the point where the Coast Guard monitors ship traffic. Establishing vessel traffic systems at a greater number of ports, extending radar coverage farther out to sea, and requiring frequent ship-to-shore communication over that coverage, would reduce the probability of an accident. The system would be similar to the air traffic control system, consisting of a traffic control center, traffic separation, movement reporting, and enforcement. Such comprehensive coverage, however, would require a substantial increase in Coast Guard resources.

Bonding and Insurance

All ships and other components of the transportation system carrying petroleum or petroleum products could be required to increase their insurance against accident, either by posting bonds or by buying an insurance policy. As described in the next section, Congress is considering legislation that would create an oil transportation fee to fund cleanup and compensation costs above the liability limits of the responsible party. The bills would also raise these liability limits. Requirements for bonding, insurance, letters of credit, or evidence of self-insurance could be used to insure that shipping companies possessed the means to meet these obligations fully. The size of the required coverage could be made commensurate with the risk of an oil spill, which could be estimated using such factors as the historic risk associated with the size, age, and design of the tanker, and by the type of cargo. Tankers without such coverage could be barred from U.S. waters.

Oil Transport Fee

Several bills have been introduced in Congress that would impose a fee on all petroleum transported through U.S. waters. The receipts would be used to build a $1 billion dollar oil-spill liability fund to pay for cleanup and compensation when damages exceed the individual liability limits of the responsible party. Fees currently assessed under the Deepwater Port Act, the Trans-Alaskan Pipeline Authorization Act, and the Outer Continental Shelf Lands Act would be eliminated and monies now in the oil spill funds established by those acts would be transferred to the new fund.

These bills incorporate fees into broader oil-spill legislation. The fees proposed by the bills range from 1.3 to 3 cents per barrel. In addition, the fees are not limited to oil transported by tankers. One bill, for instance, imposes a fee on all imported and domestically produced oil, regardless of whether or not it is transported over water.

Proposed liability limits vary, but in each bill, the limits are higher for tankers than for other vessels. Inland oil barges would be treated the same as tankers in some of the bills. In some of the bills, liability limits for operators of offshore ports would be the same as those for all other onshore and offshore petroleum-related facilities. One bill proposes equal liability limits for all facilities except for Outer Continental Shelf oil exploration and production facilities, which would have higher limits.

A variation on this approach would be to base fees and liability limits on the risks arising from the particular methods of handling petroleum. For instance, if it is determined that offshore oil terminals are environmentally preferable to existing port facilities, then oil offloaded at existing ports could be charged a higher fee than oil offloaded at offshore oil terminals. Other factors on which variations could be based include the size, age, and design of the ship; the type of crude or product carried; the regulatory standards of the flag nation; and the proximity of shipping channels to particularly sensitive areas.

Differential fees would serve two purposes. First, by setting fees according to relative risks, the fee structure would be more equitable. Second, differential fees would provide incentives to industry to handle petroleum in the least risky manner.

Oil Import Fee

One option with broader impact would be to impose an oil import fee, which would reduce the probability of an oil spill by reducing the growth in imports over the long term. The fee would raise the price of oil to domestic consumers, thereby providing incentives for increased conservation, increased domestic production, and greater use of alternative fuels. With less imported oil, the risk of a spill occurring would also decrease.

However, an oil import fee, in addition to its effect on oil-spill risks, broadly affects the economy. The Department of Energy performed an analysis of import fees for its March 1987, Energy Security report. A $10 per barrel fee applied to a base price of $22 was found to have the following advantages:

- Increased domestic production of 500,000 barrels per day by 1995.
- Reduced imports by 1.5 million barrels per day by 1995.
- Reduced payments for imports due to the decreased demand for imports and a lower oil price outside the United States.
- Reduced impacts in the event of a supply disruption.
- Increased employment by 120,000 in the petroleum and petroleum equipment sectors.
- Fee receipts of $17 - $32 billion per year.

The disadvantages included:

- Increased energy costs of $0.16 per gallon for gasoline.
- An increase in the Consumer Price Index of 2 - 3 percent.
- Reduced economic activity due to decreased discretionary income and consumer spending, reduced international competitiveness of U.S. manufactured goods, and less efficient investment. The Department of Energy estimated the GNP loss at $30 - $45 billion per year.
- Net reduction in employment of 400,000.

The Department of Energy concluded that the net loss to the economy from a $10 per barrel oil import fee would be $150 - $200 billion over the 1988 - 1995 period.

If the major objective of a policy is to reduce the risk of oil spills, then an oil import fee is not the most effective approach. A fee would not directly reduce the probability of a spill because it does not directly affect the oil transportation network or the liability arising from spill damages. An import fee would reduce oil-spill risk only indirectly, through a mechanism that affects the economy as a whole.

Combinations of Other Actions

A combination of the actions discussed above could be the most effective way to reduce the risk of tanker spills. For instance, regulations could both tighten standards on tankers and increase their liability for damages. Offshore oil terminal facilities may be appropriate for the few ports that handle larger volumes of petroleum, combined with other actions to reduce risks around smaller ports.

CONCLUSIONS

- The Department of Energy projections indicate there will be an continuing increase in the volume of imported oil consumed by the United States between now and the year 2000. Most of this oil will arrive by tanker. In addition, tanker transport of significant quantities of domestically produced oil will continue.

- The majority of the Nation's petroleum volume could be handled realistically with the construction of offshore oil in as few as six locations: Valdez, Los Angeles, Houston, Port Arthur/Beaumont, Philadelphia and New York.

- The construction and use of offshore oil terminals may provide a means for reducing the incidence of tanker accidents and tanker-related oil spills and the consequent environmental damage.

- Replacement of all nearshore tanker and barge traffic with offshore oil terminals and pipeline distribution networks would be expensive, and sources of funding are uncertain.

- Although they appear to have the potential to reduce nearshore tanker accidents and oil spills resulting from routine tanker operations, significant questions remain as to the environmental and economic effects of building offshore oil terminals. Consequently, a conclusion about whether or not the use of offshore oil terminals could sufficiently reduce the risk associated with oil shipping operations to justify their costs cannot be made without substantial further analysis. The specific environmental and operating characteristics of likely U.S. offshore oil terminals, including their design and geographic location would have to be essential elements of the analysis.

- Risks in transporting crude oil and petroleum products could be reduced through other means, including stricter regulation, increased liability, or oil transport fee based on risk. These measures could be imposed separately or in conjunction with the construction of offshore oil terminals.

ENDNOTES

1. Includes crude oil, lease condensate, natural gas plant liquids, processing gain, blending components, other hydrocarbons, and synthetic crude production.

2. Total petroleum imports in 1988 were 7.4 million barrels per day of which about 1.0 million barrels per day of oil were imported from Canada by pipeline. EIA expects imports from Canada to decline over the next decade.

3. Dead weight tonnage is the capacity of a vessel in long tons of cargo. For oil tankers, an 80,000 DWT tanker has a capacity of about 584,000 barrels of oil. (One long ton equals approximately 7.3 barrels of petroleum.)

4. Most of the remainder is produced in the following States: Wyoming (311 thousand barrels per day (tbd)), New Mexico (194 tbd), Kansas (160 tbd), North Dakota (107 tbd), Utah (90 tbd), Colorado (88 tbd), Montana (64 tbd), Michigan (63 tbd), and Illinois (61 tbd).

5. Although there are no precise definitions of the terms, most sources indicate that VLCC's have a capacity of about 150,000 - 400,000 DWT and that ULCC's have a capacity of about 400,0000 - 700,000 DWT.

6. Lightering is the process of offloading a cargo from a vessel to a smaller vessel that transports the cargo to its final destination.

7. The 11 ports, in descending order of size, are defined as follows: 1. New York; 2. Los Angeles (includes Long Beach and El Segundo); 3. Valdez (includes Whittier); 4. Houston (includes Galveston, Texas City, and Baytown); 5. Beaumont (includes Port Arthur, Orange, and Sabine Pass); 6. New Orleans (includes Baton Rouge); 7. Philadelphia (includes Wilmington and Trenton); 8. San Francisco (includes Oakland, Redwood City and Richmond); 9. Pascagoula (includes Biloxi and Gulfport); 10. Boston (includes Salem, Portsmouth, and Gloucester); and 11. Seattle (includes Anacortes, Tacoma, Townsend, Angeles Harbor, and Bellingham).

8. The Territorial Sea was extended to 12 miles in 1988 (*Proclamation 5928 of December 27, 1988)*. The purpose of this proclamation was to conform with the limits permitted by international law. The President noted however that "Nothing in this Proclamation: (a) extends or otherwise alters Federal or State law or any jurisdiction, rights, legal interests, or obligations derived therefrom..." The Solicitor's Office advises that there has been no

change in the position of the Executive Branch that the Deepwater Port Act continues to apply within the 3-to-12 mile zone.

9. Except that if it can be shown that such damage was the result of gross negligence or willful misconduct within the priority and knowledge of the licensee then such licensee is liable for the full amount of all cleanup costs and damages.

10. More than 250 offshore terminals are in operation worldwide, primarily in oil exporting regions. Water depths and handling capabilities vary widely, but the majority are deepwater terminals capable of handling VLCC's and ULCC's.

11. These estimates, prepared by consulting engineers, were contained in site-specific studies or proposals. Actual storage requirements will vary according to location.

Appendix I United States Ports by Amount of Oil Handled - 1987

Contents

Figure 1 - East Coast Oil Ports

Figure 2 - Gulf Coast Oil Ports

Figure 3 - West Coast Oil Ports

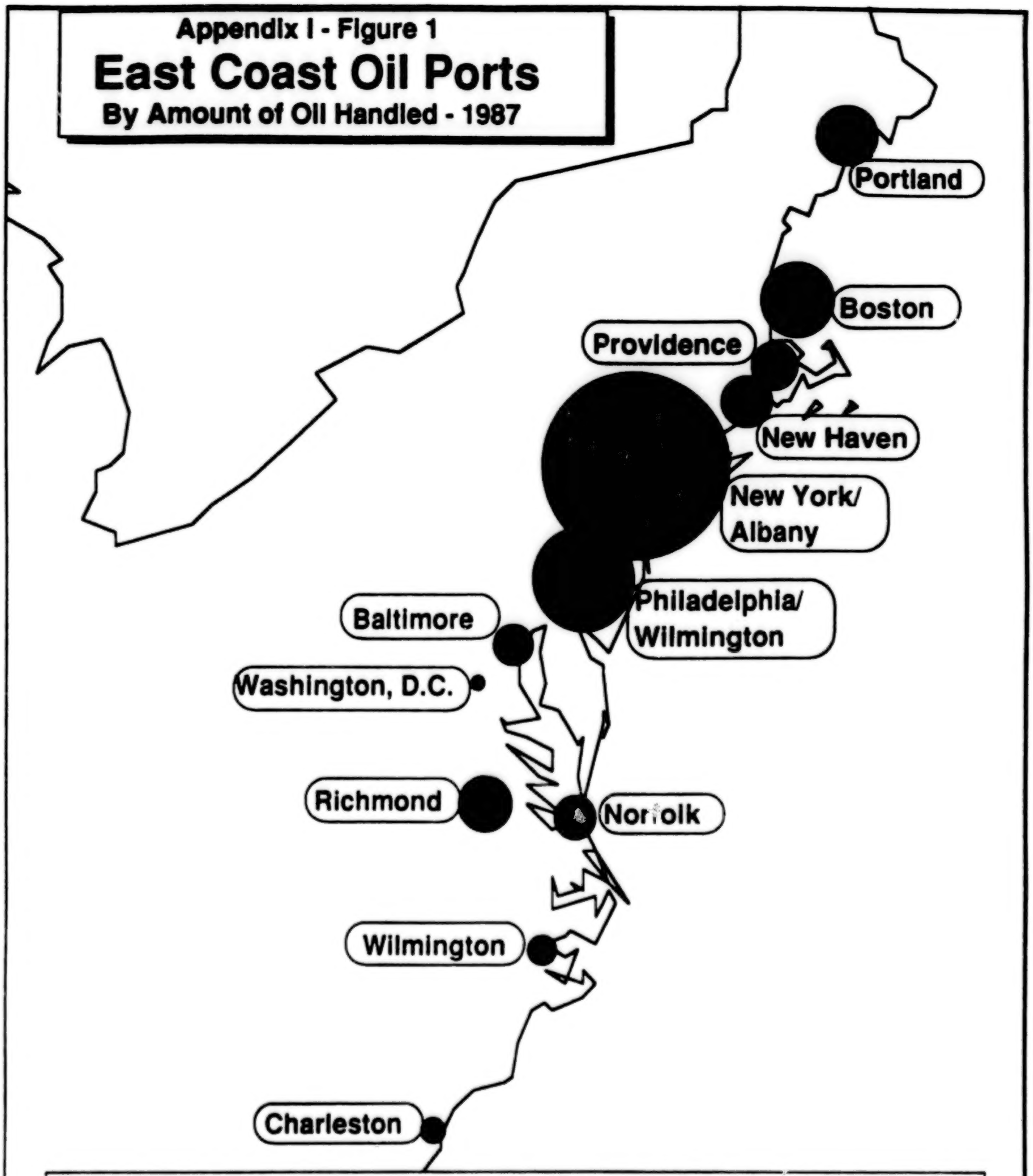
Figure 4 - Alaska and Hawaii Oil Ports

Table 1 - Summary of 1987 Tanker and Barge Traffic

Appendix I - Figure 1

East Coast Oil Ports

By Amount of Oil Handled - 1987



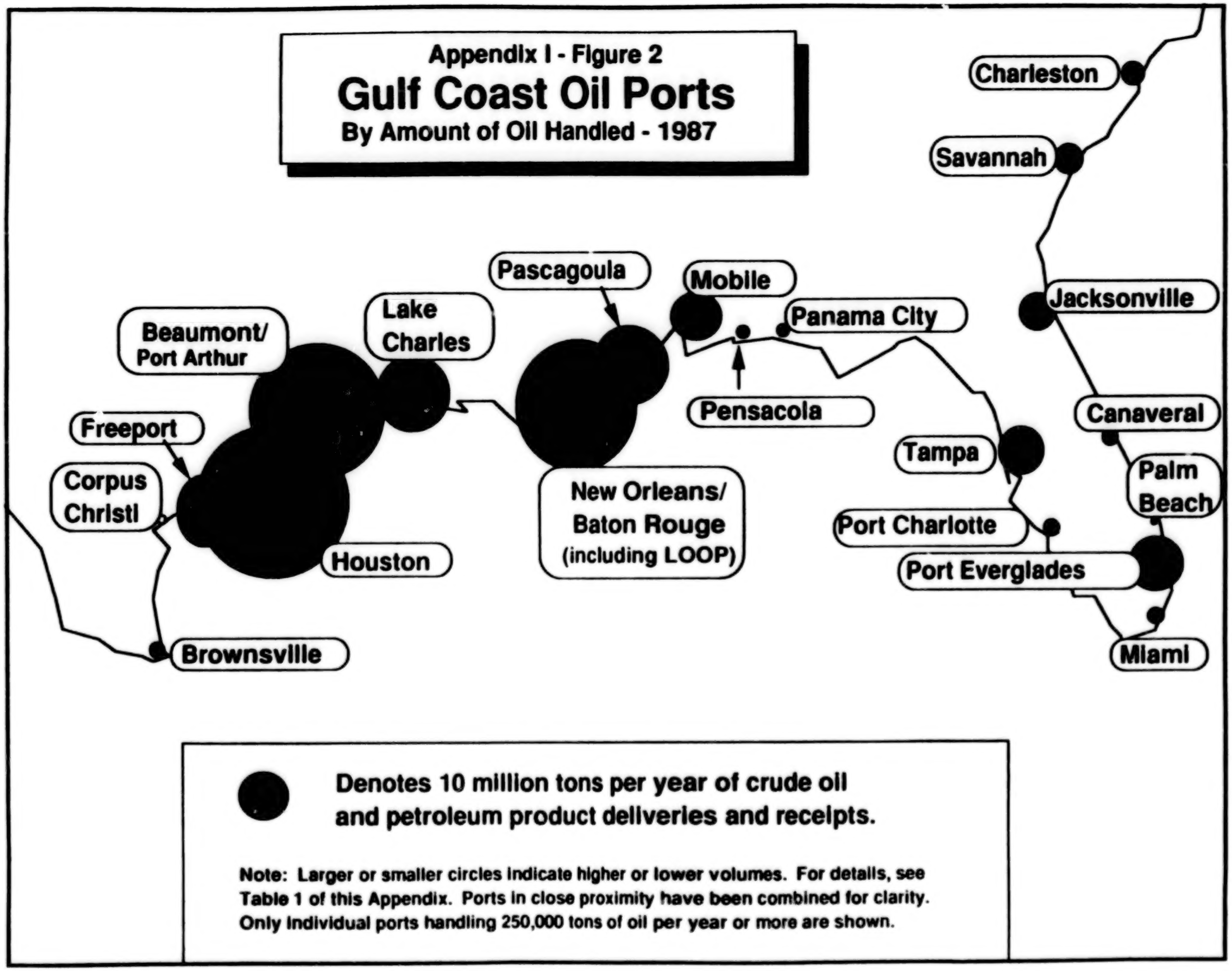
● **Denotes 10 million tons per year of crude oil and petroleum product deliveries and receipts.**

Note: Larger or smaller circles indicate higher or lower volumes. For details, see Table 1 of this Appendix. Ports in close proximity have been combined for clarity. Only individual ports handling 250,000 tons of oil per year or more are shown.

Appendix I - Figure 2

Gulf Coast Oil Ports

By Amount of Oil Handled - 1987



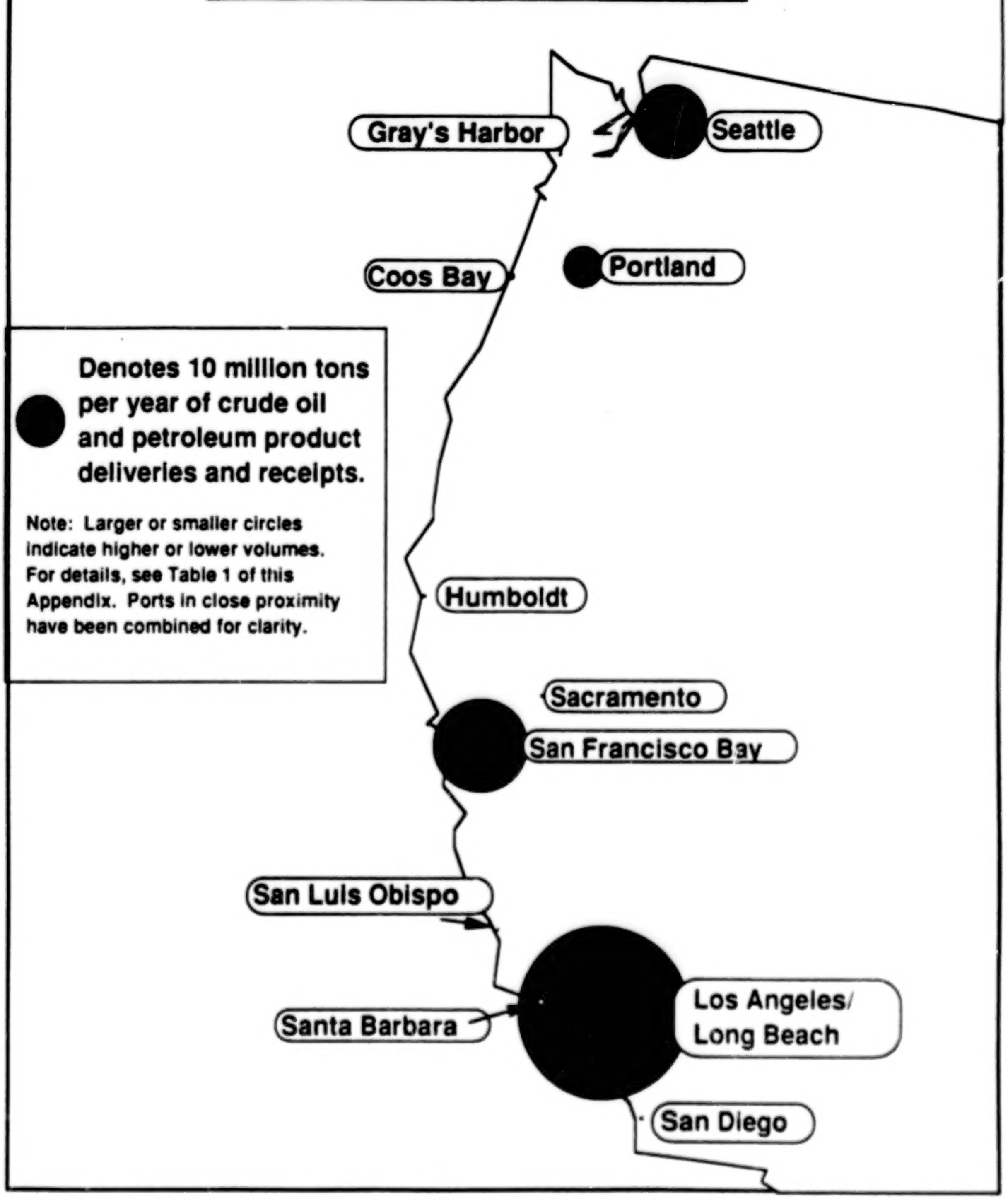
● Denotes 10 million tons per year of crude oil and petroleum product deliveries and receipts.

Note: Larger or smaller circles indicate higher or lower volumes. For details, see Table 1 of this Appendix. Ports in close proximity have been combined for clarity. Only individual ports handling 250,000 tons of oil per year or more are shown.

Appendix I - Figure 3

West Coast Oil Ports

By Amount of Oil Handled

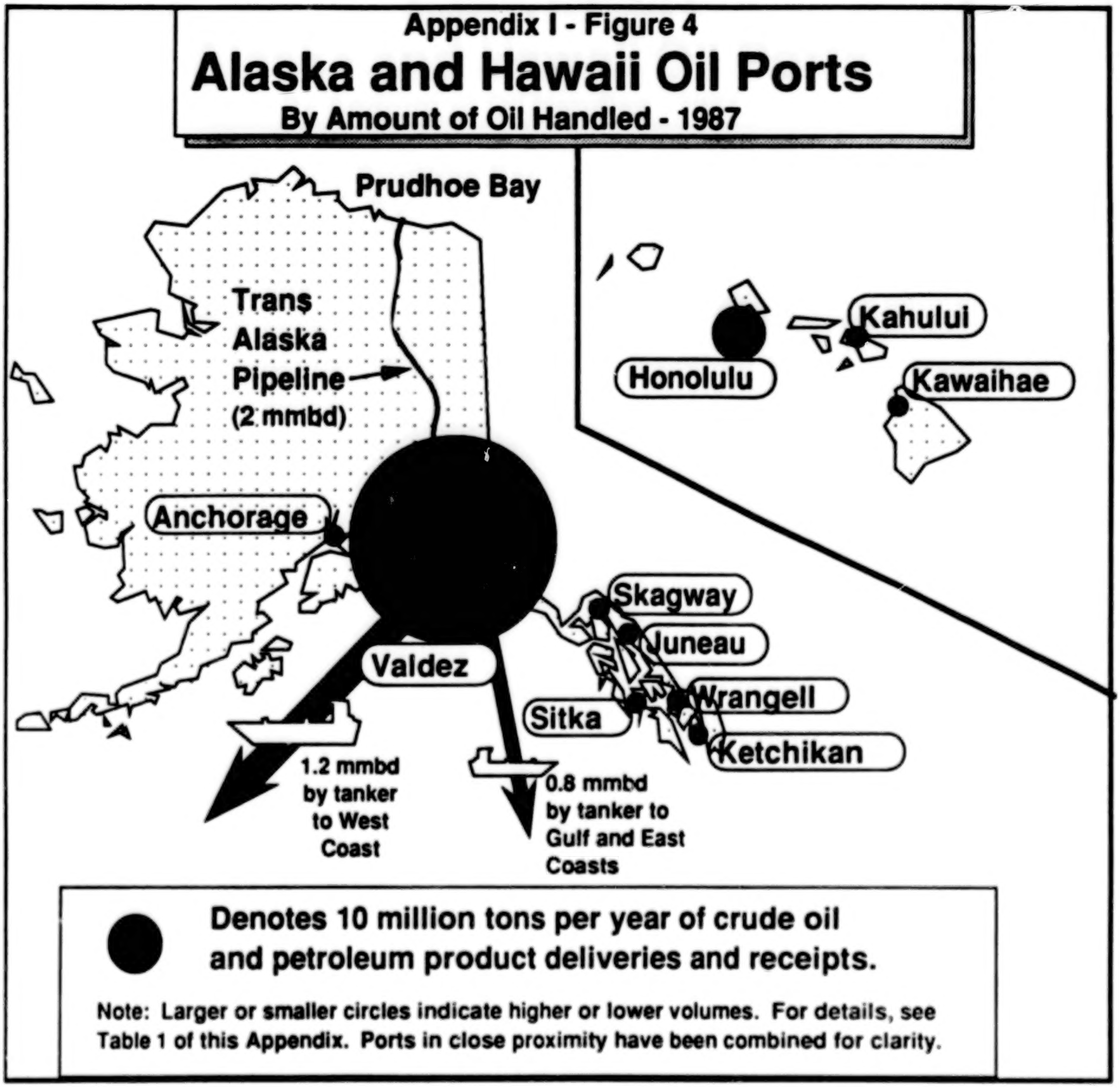

Gray's Harbor
Seattle
Coos Bay
Portland
● Denotes 10 million tons per year of crude oil and petroleum product deliveries and receipts.
Note: Larger or smaller circles indicate higher or lower volumes. For details, see Table 1 of this Appendix. Ports in close proximity have been combined for clarity.
Humboldt
Sacramento
San Francisco Bay
San Luis Obispo
Santa Barbara
Los Angeles/ Long Beach
San Diego

2d

Appendix I - Figure 4

Alaska and Hawaii Oil Ports

By Amount of Oil Handled - 1987


Prudhoe Bay
Trans Alaska Pipeline (2 mmbd)
Anchorage
Valdez
1.2 mmbd by tanker to West Coast
0.8 mmbd by tanker to Gulf and East Coasts
Skagway
Juneau
Wrangell
Sitka
Ketchikan
Honolulu
Kahului
Kawaihae
● Denotes 10 million tons per year of crude oil and petroleum product deliveries and receipts.

Note: Larger or smaller circles indicate higher or lower volumes. For details, see Table 1 of this Appendix. Ports in close proximity have been combined for clarity.

Table I

Summary of 1987 Tanker and Barge Traffic

TOTAL TONNAGE	REGION	CRUDE TONNAGE TOTAL	PETROLEUM TONNAGE TOTAL	TOTAL TONNAGE	BARGE TONNAGE TOTAL	TANKER & FOREIGN TOTAL
31,823,413	N. NEW ENGLAND	3,578,858	28,244,555	31,823,413	11,972,559	19,850,854
18,375,317	S. NEW ENGLAND	0	18,375,317	18,375,317	13,102,408	5,272,909
189,236,383	MID-ATLANTIC	30,964,404	158,271,979	189,236,383	96,967,787	92,096,984
29,986,262	SOUTH ATLANTIC	1,870,851	28,115,411	29,986,262	10,300,689	19,685,573
115,306,015	EAST GULF	46,493,604	68,812,411	115,306,015	63,921,057	51,384,958
199,731,939	WEST GULF	128,422,659	71,309,280	199,731,939	59,537,998	140,193,941
138,814,743	CALIFORNIA	41,125,262	97,689,481	138,814,743	28,143,355	110,671,388
25,472,688	NORTHWEST	11,527,194	13,945,494	25,472,688	6,320,313	19,152,375
107,994,326	ALASKA	106,977,050	1,017,276	107,994,326	353,782	107,640,544
8,234,735	HAWAII	5,337,679	2,897,056	8,234,735	1,134,539	7,100,196
864,975,821	UNITED STATES	376,297,561	488,678,260	864,975,821	291,754,487	573,049,722

Table I

Summary of 1987 Tanker and Barge Traffic

TOTAL TONNAGE	REGION	PORT	CRUDE TONNAGE TOTAL	PETROLEUM TONNAGE TOTAL	TOTAL TONNAGE TOTAL	BARGE TONNAGE TOTAL	TANKER & TONNAGE FOREIGN
31,823,413	N. NEW ENGLAND		3,578,858	28,244,555	31,823,413	11,972,559	19,850,854
584,829		SEARSPORT ME	0	584,829	584,829	146,379	438,450
8,865,541		PORTLAND ME	3,509,528	5,356,013	8,865,541	2,598,832	6,266,709
1,554,490		BRIDGEPORT ME	0	1,554,490	1,554,490	1,168,581	385,909
598,860		BUCKSPORT HBR	0	598,860	598,860	145,839	453,021
2,497,324		PORTSMOUTH NH	0	2,497,324	2,497,324	774,869	1,722,455
9,165		GLOUCESTER MA	0	9,165	9,165	0	9,165
688,669		SALEM MA	0	688,669	688,669	262,264	426,405
17,024,535		BOSTON MA	69,330	16,955,205	17,024,535	6,875,795	10,148,740
18,375,317	S. NEW ENGLAND		0	18,375,317	18,375,317	13,102,408	5,272,909
235,920		NEW BEDFORD MA	0	235,920	235,920	200,052	35,868
2,369,632		FALL RIVER MA	0	2,369,632	2,369,632	1,882,212	487,420
6,080,400		PROVIDENCE RI	0	6,080,400	6,080,400	3,409,511	2,670,889
450,104		NEW LONDON CT	0	450,104	450,104	273,294	176,810
540,256		NORWALK CT	0	540,256	540,256	517,516	22,740
5,821,276		NEW HAVEN CT	0	5,821,276	5,821,276	5,142,668	678,608
2,653,772		BRIDGEPORT CT	0	2,653,772	2,653,772	1,490,476	1,163,296
223,957		STAMFORD CT	0	223,957	223,957	186,679	37,278

Table I Summary of 1987 Tanker and Barge Traffic

TOTAL TONNAGE	REGION	PORT	CRUDE TONNAGE TOTAL	PETROLEUM TONNAGE TOTAL	TOTAL TONNAGE	BARGE TONNAGE TOTAL	TANKER & FOREIGN TOTAL
189,236,383	MID-ATLANTIC		30,964,404	158,271,979	189,236,383	96,967,787	92,096,984
6,618,466		ALBANY NY	434,457	6,184,009	6,618,466	4,567,269	2,051,197
97,092		TARRYTOWN NY	0	97,092	97,092	72,563	24,529
501,232		HEMPSTEAD NY	0	501,232	501,232	485,690	15,542
120,007,857		NEW YORK NY	10,601,788	109,406,069	120,007,857	58,568,831	61,439,026
55,321		TRENTON NJ	0	55,321	55,321	55,321	0
35,274,185		PHILADELPHIA PA	19,006,276	16,267,909	35,274,185	12,406,998	22,867,187
1,240,988		WILMINGTON DE	394,063	846,925	1,240,988	798,475	442,513
6,777,608		BALTIMORE MD	0	6,777,608	6,777,608	4,374,669	2,231,327
463,442		WASHINGTON DC	0	463,442	463,442	463,442	0
11,582,303		JAMES RIVER VA	0	11,582,303	11,582,303	11,401,592	180,711
1,782,538		NEWPORT NEWS VA	414,225	1,368,313	1,782,538	590,697	1,191,841
4,835,351		NORFOLK VA	113,595	4,721,756	4,835,351	3,182,240	1,653,111
29,986,262	SOUTH ATLANTIC		1,870,851	28,115,411	29,986,262	10,300,689	19,685,573
236,872		MOREHEAD CTY NC	0	236,872	236,872	40,335	196,537
2,628,848		WILMINGTON NC	0	2,628,848	2,628,848	848,391	1,780,457
12,509		GEORGETOWN SC	0	12,509	12,509	12,509	0
2,545,053		CHARLESTON SC	39,296	2,505,757	2,545,053	916,133	1,628,920
4,086,163		SAVANNAH GA	1,295,034	2,791,129	4,086,163	1,325,396	2,760,767
71,917		BRUNSWICK GA	0	71,917	71,917	71,578	339
6,027,929		JACKSONVILLE FL	57,864	5,970,065	6,027,929	2,507,627	3,520,302
39,942		FERNANDINA FL	0	39,942	39,942	39,828	114
1,079,674		CANAVERAL FL	0	1,079,674	1,079,674	265,346	814,328
292,228		PALM BCH FL	0	292,228	292,228	196,780	95,448
11,527,311		PORT EVERGLADES FL	440,626	11,086,685	11,527,311	3,311,408	8,215,903
1,437,816		MIAMI FL	38,031	1,399,785	1,437,816	765,358	672,458

Table I Summary of 1987 Tanker and Barge Traffic

TOTAL TONNAGE	REGION	PORT	CRUDE TONNAGE TOTAL	PETROLEUM TONNAGE TOTAL	TOTAL TONNAGE	BARGE TONNAGE TOTAL	TANKER & FOREIGN TOTAL
115,306,015	EAST GULF		46,493,604	68,812,411	115,306,015	63,921,057	51,384,958
1,005,972		PT CHARLOTTE FL	0	1,005,972	1,005,972	793,286	212,686
8,933,276		TAMPA FL	59,357	8,873,919	8,933,276	5,542,077	3,391,199
783,403		WEEDON ISL FL	0	783,403	783,403	185,773	597,630
897,789		PANAMA CITY FL	0	897,789	897,789	897,789	0
67,150		ST JOE HRB FL	0	67,150	67,150	67,150	0
889,769		PENSACOLA FL	0	889,769	889,769	759,665	130,104
9,448,753		MOBILE AL	4,223,367	5,225,386	9,448,753	7,856,455	1,592,298
158,931		BILOXI MS	0	158,931	158,931	158,931	0
110,570		GULFPORT MS	0	110,570	110,570	106,507	4,063
24,494,710		PASCAGOULA MS	14,223,567	10,271,143	24,494,710	7,367,469	17,127,241
26,022,687		BATON ROUGE LA	10,599,862	15,422,825	26,022,687	12,951,853	13,070,834
42,493,005		NEW ORLEANS LA	17,387,451	25,105,554	42,493,005	27,234,102	15,258,903
199,731,939	WEST GULF		128,422,659	71,309,280	199,731,939	59,537,998	140,193,941
22,745,670		LAKE CHARLES LA	16,964,352	5,781,318	22,745,670	7,126,195	15,619,475
17,328,123		PORT ARTHUR TX	8,199,174	9,128,949	17,328,123	4,420,687	12,907,436
553,193		SABINE PASS TX	551,693	1,500	553,193	553,193	0
54,752,494		BEAUMONT TX	47,040,345	7,712,149	54,752,494	10,427,255	44,325,239
29,380,012		TEXAS CITY TX	22,551,382	6,828,630	29,380,012	7,234,475	22,145,537
142,489		ORANGE TX	11,034	131,455	142,489	142,489	0
771,069		GALVESTON TX	153,368	617,701	771,069	508,108	262,961
63,760,327		HOUSTON TX	24,440,233	39,320,094	63,760,327	26,611,382	37,148,945
50,879		MATAGORDA SHIP TX	44,047	6,832	50,879	50,879	0
8,263,037		FREEPORT TX	7,780,170	482,867	8,263,037	1,031,583	7,231,454
223,963		VICTORIA TX	0	223,963	223,963	223,963	0
519,011		HARBOR ISL TX	482,721	36,290	519,011	365,643	153,368
204,140		PORT ISABEL TX	204,140	0	204,140	204,140	0

TOTAL TONNAGE	REGION	PORT	CRUDE TONNAGE TOTAL	PETROLEUM TONNAGE TOTAL	TOTAL TONNAGE	BARGE TONNAGE TOTAL	TANKER & FOREIGN TOTAL
1,037,532		BROWNSVILLE TX	0	1,037,532	1,037,532	638,006	399,526
138,814,743	CALIFORNIA		41,125,262	97,689,481	138,814,743	28,143,355	110,671,388
66,028		SAN DIEGO	0	66,028	66,028	66,028	0
27,249,291		LONG BEACH	18,392,073	8,857,218	27,249,291	4,843,360	22,405,931
80,020,100		LOS ANGELES	12,723,732	67,296,368	80,020,100	8,386,156	71,633,944
494,796		ELLWOOD(Santa Barbara)	494,796	0	494,796	483,274	11,522
104,830		SACRAMENTO/STOC	0	104,830	104,830	7,835	20
894,146		OAKLAND	105,888	788,258	894,146		
685,236		SAN FRANCISCO	0	685,236	685,236	102,964	582,272
44,057		REDWOOD CITY	17,488	26,569	44,057	44,057	0
28,756,144		RICHMOND	8,808,867	19,947,277	28,756,144	13,577,728	15,178,416
111,647		HUMBOLDT BAY	0	111,647	111,647	17,090	94,557
25,472,688	NORTHWEST		11,527,194	13,945,494	25,472,688	6,320,313	19,152,375
150,442		COOS BAY OR	0	150,442	150,442	31,945	118,497
353,976		OREGON SLOUGH OR	261,949	92,027	353,976	80,609	273,367
208,623		VANCOUVER WA	0	208,623	208,623	145,246	63,377
54,592		EVERETT HRBR WA	0	54,592	54,592	37,236	17,356
581,640		LONGVIEW WA	0	581,640	581,640		
622,447		ASTORIA OR	0	622,447	622,447	104,988	517,459
65,587		KALAMA WA	0	65,587	65,587	7,623	57,964
4,080,333		PORTLAND OR	509,318	3,571,015	4,080,333	1,808,576	2,271,757
27,115		GRAY'S HRBR WA	0	27,115	27,115	27,115	0
12,413,507		ANACORTES WA	9,042,430	3,371,077	12,413,507	826,383	11,587,124
522,701		ANGELES HBR WA	594	522,107	522,701	332,677	190,024
483,650		BELLINGHAM WA	0	483,650	483,650	23,809	459,841
13,736		OLYMPIA WA	0	13,736	13,736	9,327	4,409
3,080,267		SEATTLE WA	42,745	3,037,522	3,080,267	1,918,370	1,161,897

2,805,978		TACOMA HBR WA	1,670,158	1,135,820	2,805,978	786,813	2,019,165
8,094		TOWNSEND HBR WA	0	8,094	8,094	8,076	18

TOTAL TONNAGE	REGION	PORT	CRUDE TONNAGE TOTAL	PETROLEUM TONNAGE TOTAL	TOTAL TONNAGE	BARGE TONNAGE TOTAL	TANKER & FOREIGN TOTAL
107,994,326	ALASKA		106,977,050	1,017,276	107,994,326	353,782	107,640,544
504,638		ANCHORAGE	133,750	370,888	504,638	74,233	430,405
106,839,032		VALDEZ HBR	106,825,329	13,703	106,839,032	12,662	106,826,370
27,072		WHITTIER	0	27,072	27,072	0	27,072
6,262		WRANGELL	0	6,262	6,262	6,241	21
227,032		SKAGWAY	0	227,032	227,032	1,403	225,629
93,562		SITKA HBR	0	93,562	93,562	93,562	0
269,785		KETCHIKAN	17,971	251,814	269,785	138,738	131,047
26,943		JUNEAU	0	26,943	26,943	26,943	0
8,234,735	HAWAII		5,337,679	2,897,056	8,234,735	1,134,539	7,100,196
7,111,207		BARBERS PT,OAHU	5,319,708	1,791,499	7,111,207	146,461	6,964,746
399,901		PEARL HBR	0	399,901	399,901	396,423	3,478
381,558		KAHULUI MAUI	0	381,558	381,558	380,633	925
4,146		KAUMALAPAU	0	4,146	4,146	4,146	0
14,156		KAUNAKAKAI	0	14,156	14,156	14,156	0
269,785		KAWAIHAE HBR	17,971	251,814	269,785	138,738	131,047
53,982		NAWAILIWILI	0	53,982	53,982	53,982	0

Note: In some instances, data from smaller ports have been combined with data from nearby larger ports to preclude the disclosure of proprietary data.

Source: U.S. Department of the Army, Corps of Engineers, Waterborne Commerce Statistics Center

Appendix II - 1988 Petroleum Imports and Alaskan Crude

Contents

Explanatory Notes

Table 1 - Summary of Petroleum Imports and Alaskan Crude

Table 2 - Crude Oil Imports Plus Alaskan Crude Shipments

Table 3 - Fuel Oil Imports

Table 4 - Ethane, Propane, Butane, and Natural Gas Liquids Imports

Table 5 - Motor Fuel Imports

Table 6 - Kerosene and Naphtha Imports

Table 7 - Lubricating Oil Imports

Table 8 - Lubricating Grease Imports

Table 9 - Tariff Classifications for Petroleum Imports

Figure 1 - 1988 Petroleum Imports Plus Alaskan Crude

Figure 2A - 1988 Petroleum Arrivals at PADD 1 and PADD 2

Figure 2B - 1988 Petroleum Arrivals at PADD 3 and PADD's 4 & 5

Figure 2C - 1988 Petroleum Arrivals at Hawaii and the Virgin Islands

Figure 2D - 1988 Petroleum Arrivals at Puerto Rico

Explanatory notes for Appendix II - 1988 Petroleum Imports, Plus Alaskan Crude Shipments.

(1) This appendix provides a broad view of crude oil and petroleum products shipments to the United States. The objective is to show the size of import flows to each region and the differences among regions in the mix of crude and products received. Alaskan crude is identified separately.

(2) Import data are taken from U.S. Customs Service Report IM 145, "U.S. General Imports by All Methods of Transportation, December, 1988."

(3) Report IM145 is organized by product, using tariff classifications, and within each classification by country of origin. In order to show the flows of petroleum into various regions of the United States, these data have been reorganized, within each product classification, by Petroleum Administration for Defense Districts (PADD). Within each PADD, Customs Service District Offices are listed, with the amount of petroleum declared at that office in 1988. Although Hawaii is included in PADD 5, it is listed separately here, as are Puerto Rico and the Virgin Islands, which are not included in a PADD.

(4) The Petroleum Administration for Defense Districts:

PADD 1 - ME, VT, NH, MA, NY, RI, CT, PA, NJ, WV, MD, DE, VA, NC, SC, GA, and FL. (The Atlantic Coast States.)

PADD 2 - ND, SD, NE, KA, OK, MN, IA, MO, WI, IL, IN, KY, and TN. (The Midwest States.)

PADD 3 - NM, TX, AR, LA, MS, and AL. (The Gulf Coast States.)

PADD 4 - MT, ID, WY, UT, and CO. (The Rocky Mountain States.)

PADD 5 - AK, HI, WA, OR, NV, CA, and AZ. (The Pacific States.)

(5) Quantities shown are those declared at the indicated Customs District Office, not at the ultimate destination of the shipment if that destination is different from the Customs District.

(6) This listing includes 28 tariff classifications, which have been grouped into the product headings shown. The tariff classifications are listed on each table. Descriptions of each product classification are listed in table 9.

(7) Greases and other solid products that are usually measured by weight have been converted to approximate barrel equivalent measurements for consistency in these tables. The total of such products is less than one million equivalent barrels. (The conversion was made at the rate of 300 pounds of solid for each 42-gallon barrel of petroleum.)

(8) Two product categories are not included in the imports listed: paraffin and other petroleum waxes, and petroleum asphalts.

(9) Natural gas is not included. Natural gas liquids are included.

(10) Shipments of crude from Alaska have been taken from industry data on daily average shipments and arrivals.

(11) Tariff Classification 4751555: "Derivatives of Petroleum or natural gas, not specifically provided for elsewhere," is not included in this compilation. No quantities are available for this classification; however, the total customs value for all such imports in 1988 was $198,230.

TABLE 1 - PETROLEUM IMPORTS - 1988
(Including Alaskan crude oil)

Imports from U.S. Customs Service Data*

Commodity	Barrels
Crude Oil**	2,569,530,981
Fuel Oil	426,384,991
Ethane, Propane, Butane & NGL	155,764,874
Motor Fuels	202,853,796
Kerosene and Naphtha	44,150,062
Lubricating Oil	1,816,629
Lubricating Grease	506,127
TOTAL	3,401,007,460

* Imports data are taken from report IM145, "U.S. General Imports By All Methods of Transportation," 1988. For this presentation, some data have been modified by changing units of measurement, rounding, or other means. The effects of these changes are very small (i.e., less than 1 million barrels).

** "Crude Oil" includes crude shipped from Alaska to the other 49 States. Alaskan crude provided 20.11% of the crude shipments shown here (i.e., 648,010,000 barrels).

TABLE 2 - CRUDE OIL IMPORTS PLUS ALASKAN CRUDE SHIPMENTS, 1988

U.S. Customs Service Data,* Plus Alaskan Shipments

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Buffalo, NY	20,091,271
Maine	293,547
New York, NY	50,407,406
Norfolk, VA	12,809,524
Ogdensberg, NY	214
Philadelphia, PA	325,841,747
Savannah, GA	5,993,029
Total	415,436,738
PADD 2	
Chicago, IL	86,128,776
Detroit, MI	8,243,769
Duluth, MN	74,901,987
Pembina, ND	86,819
Saint Louis, MO	57,317
Total	169,418,668
PADD 3	
Houston, TX	428,636,526
Mobile, AL	92,108,082
New Orleans, LA	505,543,869
Port Arthur, TX	101,876,082
Alaskan oil, via Panama (est.)	172,280,000
Total	1,300,444,559

Customs Service District Offices, Grouped by PADD	Barrels
PADD 4 AND PADD 5	
Great Falls, MT	24,824,009
Los Angeles, CA (imports)	25,420,800
Los Angeles, CA (Alaskan, est.)	178,850,000
San Diego, CA	1,723,548
San Francisco, CA (imports)	4,737,429
San Francisco, CA (Alaskan, est.)	136,510,000
Seattle. WA (imports)	11,295,029
Seattle, WA (Alaskan, est.)	147,460,000
Total	530,820,815
Hawaii	21,802,886
Puerto Rico	26,783,034
Virgin Islands (imports)	55,914,281
Virgin Islands (Alaskan, est.)	48,910,000
TOTAL	2,569,530,981

* Customs data: Tariff classifications 4750510 and 4751010.

TABLE 3 - FUEL OIL IMPORTS - 1988

U.S. Customs Service Data*

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Baltimore, MD	6,679,183
Boston, MA	68,349,178
Buffalo, NY	5,573,738
Charleston, SC	1,236,289
Maine	27,931,924
Miami, FL	4,137,552
New York, NY	138,079,081
Norfolk, VA	6,834,190
Ogdensberg, NY	2,437,254
Philadelphia, PA	32,213,189
Providence, RI	11,964,572
Saint Albens, VT	749,646
Savannah, GA	1,434,822
Tampa, FL	8,792,703
Wilmington, NC	3,077,909
Total	319,391,186
PADD 2	
Chicago, IL	50,354
Cleveland, OH	79,758
Detroit, MI	2,653,206
Duluth, MN	164,190
Pembina, ND	1,406,418
Total	4,353,926

Customs Service District Offices, Grouped by PADD	Barrels
PADD 3	
Dallas, TX	740
Houston, TX	40,907,406
Mobile, AL	3,070,207
New Orleans, LA	18,435,551
Port Arthur, TX	6,797,461
Total	69,229,365
PADD 4 AND PADD 5	
Alaska	729,388
Columbia - Snake River	230,573
Great Falls, MT	1,564,485
Los Angeles, CA	6,024,879
San Diego, CA	380,328
San Francisco, CA	2,816,850
Seattle. WA	1,086,014
Total	12,832,517
Hawaii	528,361
Puerto Rico	19,488,698
Virgin Islands	450,938
TOTAL	426,384,991

*Customs data: Tariff classifications 4750525, 4750535, 4750545, 4751015, 4751025, and 4751035.

TABLE 4 - ETHANE, PROPANE, BUTANE, AND NATURAL GAS LIQUIDS IMPORTS - 1988

U.S. Customs Service Data*

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Boston, MA	338,500
Buffalo, NY	3,337,380
Charleston, SC	1,805
Maine	3,651,876
New York, NY	3,752,077
Norfolk, VA	651,808
Ogdensberg, NY	1,049,535
Philadelphia, PA	2,183,264
Providence, RI	1,727,645
Saint Albans, VT	412,089
Savannah, GA	33,921
Total	17,139,900
PADD 2	
Chicago, IL	53,203
Detroit, MI	15,639,874
Duluth, MN	624,211
Pembina, ND	13,825,529
Total	30,142,885
PADD 3	
Dallas, TX	113
Houston, TX	72,765,282
Laredo, TX	11
New Orleans, LA	14,470,668
Port Arthur, TX	301,040
Total	87,537,114

Customs Service District Offices, Grouped by PADD	Barrels
PADD 4 AND PADD 5	
Alaska	79,573
Great Falls, MT	4,496,879
Los Angeles, CA	5,299,364
San Francisco, CA	1,653,534
Seattle, WA	4,242,217
Total	15,771,567
Hawaii	74,225
Puerto Rico	5,099,183
TOTAL	155,764,874

* Customs data: Tariff classifications 4751515, 4751525, 4751535, 4751545, 4751550, 4756510, and 4756530.

TABLE 5 - MOTOR FUELS IMPORTS - 1988

U.S. Customs Service Data*

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Baltimore, MD	43,062
Boston, MA	27,406,126
Buffalo, NY	413,564
Charleston, SC	302,126
Maine	6,542,982
Miami, FL	11,539,748
New York, NY	92,491,567
Norfolk, VA	698
Ogdensberg, NY	229,336
Philadelphia, PA	7,459,339
Providence, RI	7,045,474
Saint Albans, VT	141,570
Savannah, GA	369,461
Tampa, FL	3,115,405
Total	157,807,429
PADD 2	
Chicago, IL	4,855,692
Cleveland, OH	179,301
Detroit, MI	1,545,293
Duluth, MN	2,882
Pembina, ND	1,860,854
Total	8,444,022

Customs Service District Offices, Grouped by PADD	Barrels
PADD 3	
Houston, TX	3,108,757
Laredo, TX	1,047,399
New Orleans, LA	1,203,268
Port Arthur, TX	258,803
Total	5,618,227
PADD 4 AND PADD 5	
Alaska	1,589,029
Columbia - Snake River	1,760,504
Great Falls, MT	625,064
Los Angeles, CA	8,861,451
San Francisco, CA	3,163,741
Seattle, WA	3,271,281
Total	19,271,070
Hawaii	581,454
Puerto Rico	11,121,564
Virgin Islands	11,030
TOTAL	202,853,796

---

* Customs data: Tariff classifications 4752524, 4752428, 4752430, 4752450, 4752560, and 4752700.

TABLE 6 - KEROSENE AND NAPHTHA IMPORTS - 1988

U.S. Customs Service Data*

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Boston, MA	115,118
Buffalo, NY	418,407
Charleston, SC	689
Maine	308,422
Miami, FL	1,442
New York, NY	4,252,752
Ogdensberg, NY	244,913
Philadelphia, PA	947,925
Saint Albans, VT	68,695
Savannah, GA	143
Tampa, FL	2
Total	6,358,508
PADD 2	
Chicago, IL	120,640
Detroit, MI	186,609
Pembina, ND	2,128
Total	309,377
PADD 3	
Houston, TX	12,100,652
New Orleans, LA	4,243,541
Port Arthur, TX	4,006,173
Total	20,350,366

Customs Service District Offices, Grouped by PADD	Barrels
PADD 4 AND PADD 5	
Great Falls, MT	521,751
Los Angeles, CA	59,598
San Francisco, CA	454,505
Seattle, WA	96,281
Total	1,132,135
Puerto Rico	15,999,676
TOTAL	44,150,062

* Customs data: Tariff classifications 4753000 and 4753500.

TABLE 7 - LUBRICATING OIL IMPORTS - 1988

U.S. Customs Service Data*

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Baltimore, MD	31,296
Boston, MA	44,471
Buffalo, NY	313,352
Charleston, SC	764
Maine	2,288
Miami, FL	311
New York, NY	12,951
Norfolk, VA	635
Ogdensberg, NY	2,244
Philadelphia, PA	346,056
Saint Albans, VT	104
Savannah, GA	4,031
Tampa, FL	35,793
Washington, DC	278
Wilmington, NC	107
Total	794,681
PADD 2	
Chicago, IL	1,186
Cleveland, OH	2,973
Detroit, MI	211.429
Milwaukee, WI	24
Minneapolis, MN	3
Pembina, ND	946
Saint Louis, MO	2
Total	216,563

Customs Service District Offices, Grouped by PADD	Barrels
PADD 3	
Dallas, TX	573
Houston, TX	227,387
Laredo, TX	60,347
Mobile, AL	82
New Orleans, LA	236,176
Port Arthur, TX	71,800
Total	596,365
PADD 4 AND PADD 5	
Columbia - Snake River	91
Great Falls, MT	105
Los Angeles, CA	102,605
Nogales, AZ	29
San Francisco, CA	48,684
Seattle, WA	4,024
Total	155,538
Puerto Rico	53,482
TOTAL	1,816,629

* Customs data: Tariff classifications 4754000 and 4754500. Imports of classification 4754000, "Mineral Oil, Medicinal, Derived From Petroleum," amount to less than 1000 barrels.

TABLE 8 - LUBRICATING GREASE IMPORTS - 1988

U.S. Customs Service Data*

Customs Service District Offices, Grouped by PADD	Barrels
PADD 1	
Baltimore, MD	44
Boston, MA	140
Buffalo, NY	47,357
Charleston, SC	40
Maine	38
Miami, FL	100
New York, NY	1,029
Norfolk, VA	280
Ogdensberg, NY	10,777
Philadelphia, PA	659
Saint Albans, VT	3,770
Savannah, GA	1,844
Tampa, FL	12
Wilmington, NC	597
Total	66,687
PADD 2	
Chicago, IL	424
Cleveland, OH	528
Detroit, MI	71,434
Milwaukee, WI	1
Saint Louis, MO	33
Total	72,420

Customs Service District Offices, Grouped by PADD	Barrels
PADD 3	
Dallas, TX	15
Houston, TX	257,948
Laredo, TX	40
Mobile, AL	155
New Orleans, LA	20,037
Port Arthur, TX	87,085
Total	365,280
PADD 4 AND PADD 5	
Columbia - Snake River	9
Great Falls, MT	186
Los Angeles, CA	474
San Francisco, CA	30
Seattle, WA	64
Total	763
Puerto Rico	987
TOTAL	506,137

* Customs data: Tariff classifications 4755500, 4756000, and 4757000. Imports of the products included in these classifications are measured by weight, not volume. However, for consistancy in this compilation of data, grease and solid hydrocarbon mixtures have been listed in barrels, at the rate of 300 pounds per barrel.

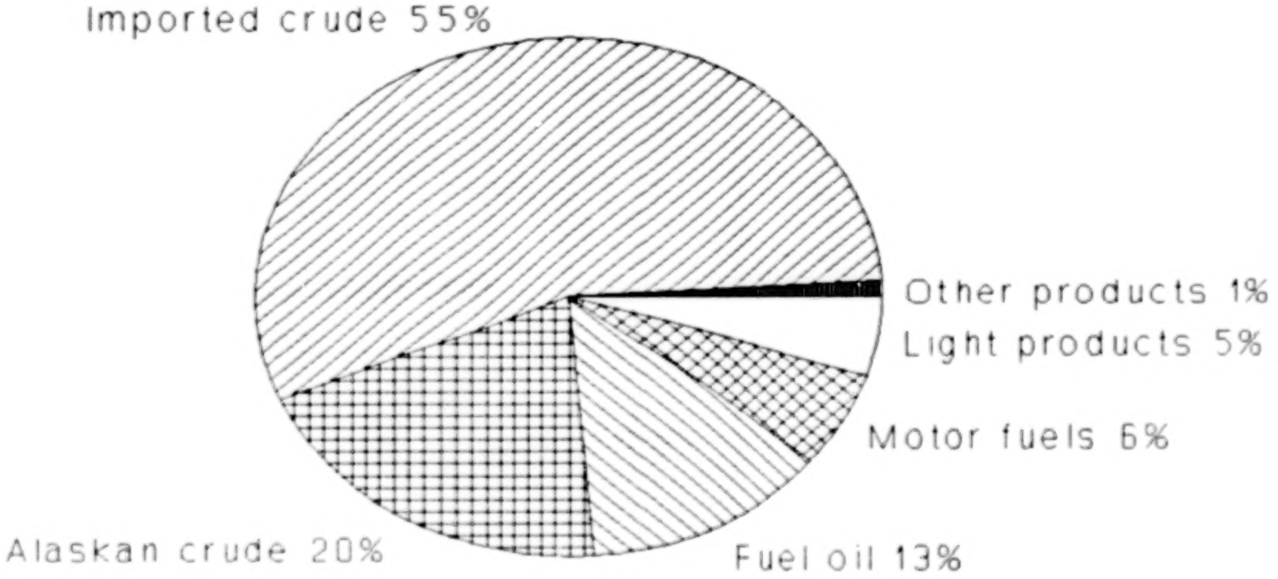
TABLE 9 - TARIFF CLASSIFICATIONS FOR PETROLEUM IMPORTS*

Number		Classification
4750501	-	Crude oil or shale oil with gravity under 25 degrees API.
0525	-	Oil having a Saybolt Universal viscosity at 100° F of 45 seconds or more, but not more than 125 seconds. (No. 4 type fuel oils.)
0535	-	Oil having a Saybolt Universal viscosity at 100° F of more than 125 seconds. (Heavy fuel oils.)
0545	-	Fuel oil not specified elsewhere, with gravity under 25 degrees API.
4751010	-	Crude oil testing 25 degrees API gravity or more.
1015	-	Oil having a Saybolt Universal viscosity at 100° F of less than 45 seconds. (Light fuel oils.)
1025	-	Oil having a Saybolt Universal viscosity at 100° F of 45 seconds or more but not more than 125 seconds. (No. 4 type fuel oils.)
1035	-	Oil having a Saybolt Universal viscosity at 100° F of more than 125 seconds. (Heavy fuel oils.)
4751515	-	Ethane with a minimum purity of 95 liquid percent.
1525	-	Propane with a minimum purity of 90 liquid percent.
1535	-	Butane with a minimum purity of 90 liquid percent.
1545	-	Mixtures containing over 90 liquid percent propane and butane.
1550	-	Mixtures containing over 90 liquid percent ethane and propane.
1555	-	Derivatives of petroleum or natural gas, not specifically provided for elsewhere.
4752524	-	Leaded gasoline.
2528	-	Unleaded gasoline.
2530	-	Jet fuel, naphtha based.
2550	-	Jet fuel, kerosene based.
2560	-	Motor fuel, not specifically provided for elsewhere.
4753000	-	Kerosene, derived from shale oil, petroleum, or both.
4753500	-	Naphthas, derived from shale oil, natural gas, etc.
4754000	-	Mineral oil, medicinal, derived from petroleum.
4754500	-	Lubricating oils from petroleum and/or shale oil.
4755500	-	Greases containing not over 10% by weight of salts of fatty acids of animal (including marine animals) or vegetable by origin.
4756000	-	Lubricating greases, not specifically provided for elsewhere.
6500	-	Other mixtures in liquid form.
6510	-	Condensate derived wholly from natural gas.
6530	-	Liquid derivatives of petroleum not specifically provided for elsewhere.
4757000	-	Hydrocarbons in other than liquid form not specifically provided for elsewhere.

---

* Products not listed in this Appendix, such as natural gas, are not included here.

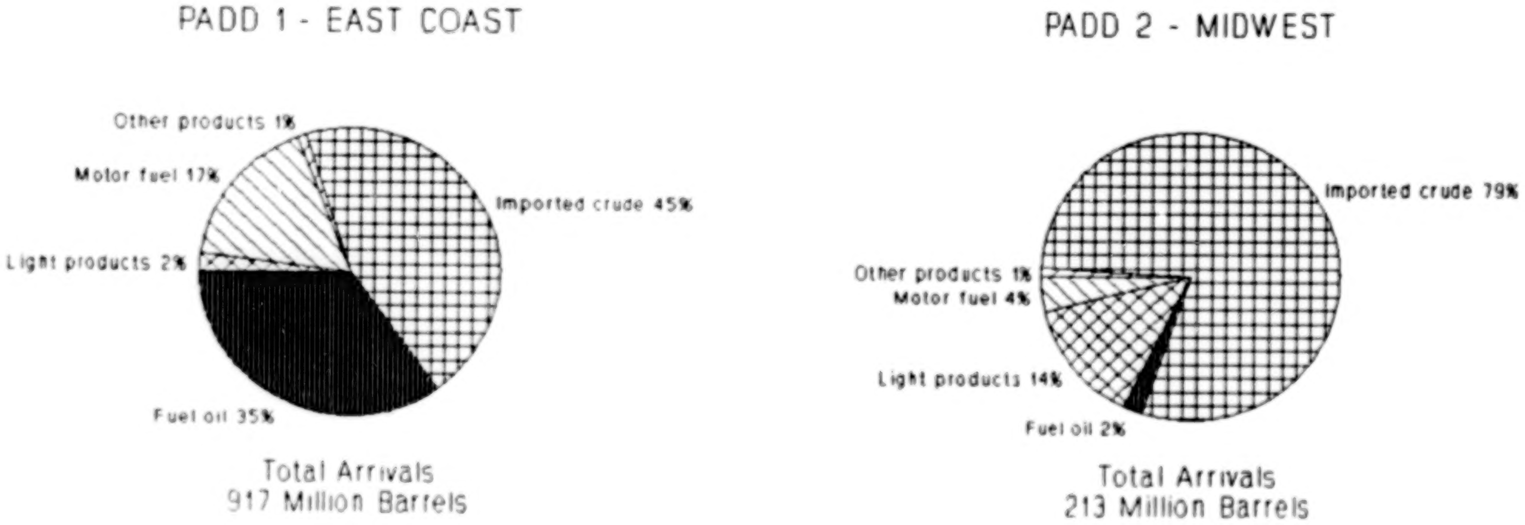
FIGURE 1. 1988 PETROLEUM IMPORTS PLUS ALASKAN CRUDE



Total Arrivals - 3401 Million Barrels

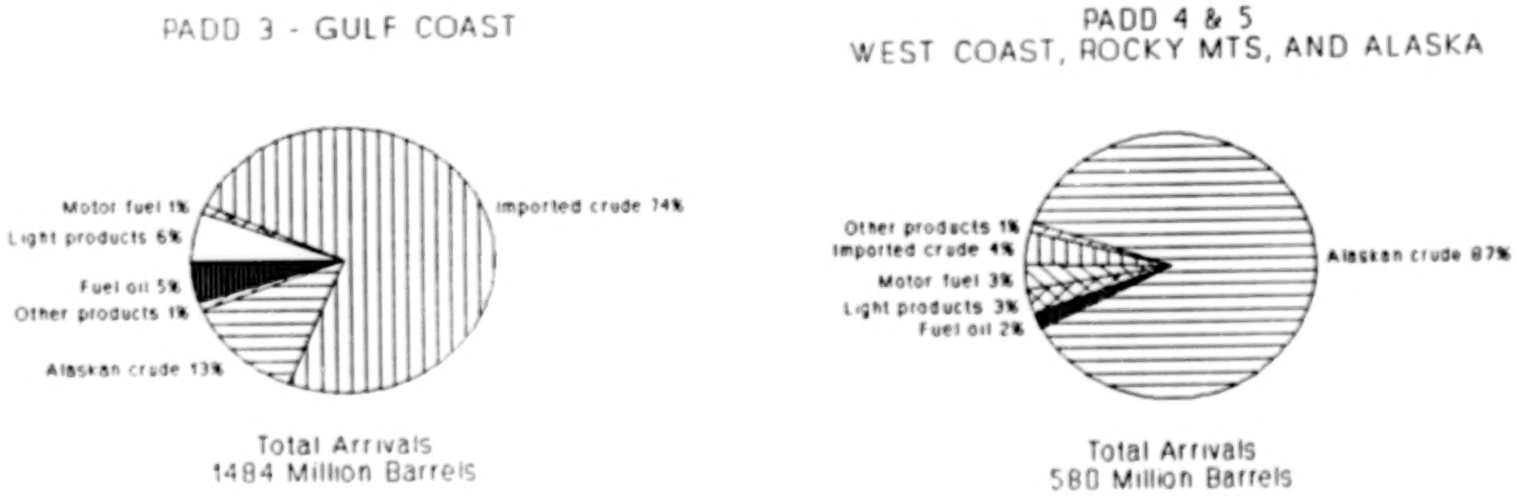
Light products = ethane, propane, butane and natural gas liquids. Other products = kerosene, naphtha and lubricants.

FIGURE 2A. 1988 ARRIVALS OF PETROLEUM



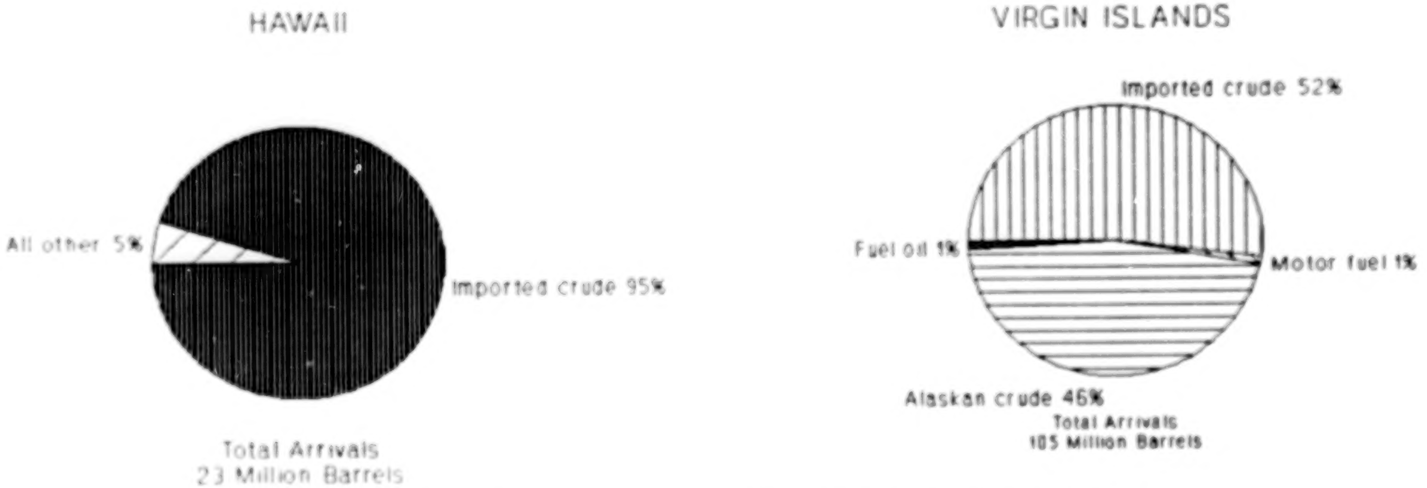
Light products = ethane, propane, butane and natural gas liquids.
Other products = kerosene, naphtha, and lubricants

FIGURE 2B. 1988 ARRIVALS OF PETROLEUM



Light products = ethane, propane, butane and natural gas liquids.
Other products = kerosene, naphtha, and lubricants.

FIGURE 2C. 1988 PETROLEUM ARRIVALS AT HAWAII AND THE VIRGIN ISLANDS

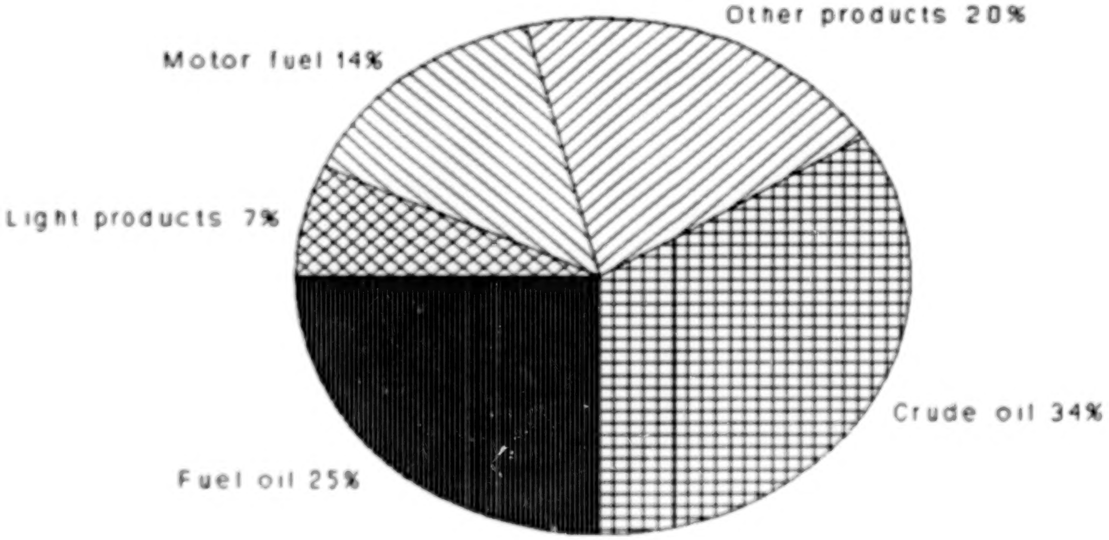


All other = fuel oil (2%), motor fuel (2%), and light products (1%).

Note: Imports of fuel oil and motor fuel were actually less than 0.5 % each.

Light products = ethane, propane, butane, and natural gas liquids.
Other products = kerosene, naphtha, and lubricants.

FIGURE 2D. ARRIVALS OF FIVE CATEGORIES OF PETROLEUM IN PUERTO RICO



Total Arrivals
79 Million Barrels

Light products = ethane, propane, butane and natural gas liquids. Other products = kerosene, naphtha, and lubricants.

Offshore Oil Terminal Cost Scenarios

This appendix provides an overview of the estimated costs for the LOOP and other recent proposals for offshore oil terminals in the United States.

a) LOOP

The following description of LOOP, with the cost of the facility's components, has been provided by LOOP officials.

$206 million -	Offshore facility including 3 single point mooring (SPM) berths, hoses to seafloor, epoxy lined 56" pipe from each SPM to terminal platform, platform, pumps, flow meters, controls, living quarters, two mooring assist boats and one standby boat.
$ 8 million -	Diesel fuel line (4") to terminal platform.
$ 92 million -	Single 48" pipeline 18 miles to shore and 28 miles inland to storage facility.
$ 24 million -	Intermediate onshore pumping station, near pipeline landfall, four 6000 hp pumps.
$300 million -	40 million barrel storage facility consisting of 8 leached caverns, instrumentation, distribution pipelines.
$ 27 million -	30" brine line for leaching system.
$ 65 million -	25 million barrel brine storage reservoir, leak detection monitoring system, lift pumps, etc.
$ 15 million -	Maintenance facility and automated operations center.
$737 million -	Total for phase 1 in 1978-1981 dollars.

Estimate for 1989 to construct LOOP - $1.193 billion.

$100 million -	1978 estimate to complete phase 2: Addition of one additional 48" pipeline to shore and one additional SPM mooring, with associated pipes and flow lines.

b) Seadock -- Texas

Proposed for 110 feet of water 26 miles off Freeport, Texas. Design throughput of 2.5 million barrels per day. Plans called for 6 SPM buoys designed to moor crude tankers from 80,000 to 550,000 DWT. Designed to continue offloading in up to 15 foot seas, and 45 knot winds with a maximum of 1 knot surface current. Crude travels to shore through 56" pipelines. Cost estimate in 1977 of $659 million for phase 1 (4 SPM) and $865 million total for the complete project (roughly $900 million and $1.18 billion in current dollars, respectively). Department of Transportation permitting slowed the Seadock project and the withdrawal of one of the major participants finally doomed the consortium.

c) Han-Padron 1989 East Coast Scenario

For this review, Han-Padron Associates, consulting engineers with considerable worldwide experience in offshore facilities, agreed to provide preliminary estimates of costs involved in constructing an offshore oil terminal off the coast of southern New Jersey to serve the Delaware River refinery complex. The site was identified by the Office of Technology Assessment (OTA) in a 1976 study of potential for offshore oil terminals on the east coast. Crude and heavy oil arrivals in this area are of roughly the same magnitude today as at the time of the OTA study.

Operating Assumptions:

- Mooring located 32 miles offshore in water depth of 120 feet
- Tank farm located approximately 15 miles inland from the point where the marine pipelines come ashore.
- Crude oil (Arabian light or equivalent) will be delivered to a refinery or existing pipeline distribution system at a distance of approximately 50 miles from the tank farm. (A Han-Padron study for an offshore oil terminal off the coast of Virginia indicated that optimum storage capacity would be 14 days of throughput.)
- Terminal throughput would be 1.6 million barrels a day.
- Maximum ship size would be 700,000 DWT and the average size would be 150,000 DWT.

Total Project Cost:

$ 30,000,000 -	Three offshore moorings.
$ 45,000,000 -	Three 8,000 foot long 56" pipelines connecting moorings with pump platform.
$160,000,000 -	Offshore booster pump platform, including platform fabrication and installation, pumps, drivers, piping, valves, and controls.
$300,000,000 -	Two 31 mile long, 56" marine pipelines to shore @ $140 million apiece and one 8" fuel line to service the platform @ $20 million.
$ 85,000,000 -	Shoreline booster pump station with 70,000 hp of pumping capacity.
$ 85,000,000 -	Two 15 mile long 56" land pipelines to transport crude to tank farm estimated @ $40 million apiece, and $5 million to obtain pipeline easements.
$290,000,000 -	Tank farm with 22 million barrels of storage in 500,000 barrel floating roof tanks, fabrication, installation piping, electrical, buildings, etc. estimated at $12 per barrel. Approximately 625 acres would be required. Land cost and availability is highly variable but for the purposes of the study was estimated at $40,000 per acre. Total of $25 million for land. Han-Padron suggests the use of surplus Federal land (Fort Dix) for the tank farm location.
$ 60,000,000 -	Pump station, 50,000 hp capacity, feeding to 50-mile long 48" delivery pipeline.
$120,000,000 -	Delivery pipeline, 50 miles long, 48" size. Estimate includes $10 million for easement.
$115,000,000 -	Contingency @ 10 percent.
$210,000,000 -	Engineering, permits, and inspections @ 16 percent.
$1,500,000,000 -	Total estimate in 1989 dollars.

d) March 1989 Department of Energy Terminal Study

In March, 1989, the Department of Energy received a contracted study of a proposed offshore marine terminal to load crude from the Big Hill Strategic Petroleum Reserve storage site onto tankers for distribution. The terminal would be located in 60 feet of water and have a capacity of 960,000 barrels per day.

$74.7 million -	10 miles of 36" onshore pipeline, 45 miles of 36" offshore pipeline and site modifications.
$13.1 million -	Platform jacket fabrication and installation, fabrication and installation of two SPM mooring buoys, boat landings, bumpers, and cathodic protection.
$ 8.1 million -	36" pipelines from SPM's to platform, pumps, fire protection system, drinking water system, compressed air system, waste water system, living quarters, support systems.
$ 1.0 million -	Electrical and instrumentation systems.
$24.3 million -	Design, project management, engineering procurement, construction management and inspection (estimated at 25% of previous subtotal).
$36.3 million	Contingency (estimated at 30%).
$157 million -	Total in 1989 dollars.

e) Pacific Texas Pipeline Company Proposal for Los Angeles Harbor

Pacific Texas proposes construction of an artificial, 106-acre "energy island" within the shelter of the Los Angeles Harbor breakwater. The ship channel would be dredged to a depth of 75 feet to allow access by up to 250,000 DWT capacity tankers. Dredge spoil would be used to construct the island, which would house docking facilities for 2 tankers, oil storage for 3 million barrels, pumps, meters, emissions control systems and fire control equipment.

The facility is designed to handle 900,000 barrels of crude oil per day through a 42" pipeline to shore for eventual linkup with the Pacific Texas Pipeline to feed refineries in Texas. This project desires to transport Alaskan crude that is currently shipped to the pipeline across the Isthmus of Panama for reshipment to Gulf coast ports.

$ 56 million - Off-site mitigation, dredging, island construction.
$ 49 million - Ship unloading system, structure, pier and wharf, and fire protection system.
$ 32 million - Steel tank storage for 3 million barrels of crude oil, oil-spill containment pond.
$ 13 million - Marine pipeline to shore, pumps, valves, etc.
$ 60 million - Innovative technology for air pollution control system.

$210 million - Total in 1989 dollars.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

U.S. DEPARTMENT OF THE INTERIOR MINERALS MANAGEMENT SERVICE

END

09/12/90